STATE OF NEW HAMPSHIRE

2000 SECTION 305(b) WATER QUALITY REPORT

NEW HAMPSHIRE DEPARTMENT OF Environmental Services

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WATER QUALITY REPORT

STATE OF NEW HAMPSHIRE
DEPARTMENT OF ENVIRONMENTAL SERVICES
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PART I

EXECUTIVE SUMMARY

INTRODUCTION

The Federal Water Pollution Control Act (PL92-500, commonly called the Clean Water Act), as last reauthorized by the Water Quality Act of 1987, requires each state to submit a report every two years, to the U.S. Environmental Protection Agency (EPA) and the U.S. Congress, describing the status of its surface and ground waters. This document, which is commonly referred to as the "305(b) Report", fulfills this federal requirement and includes an assessment of existing water quality in New Hampshire, and an overview of past and proposed water pollution abatement efforts.

New Hampshire, like many of the other New England States, has a statewide freshwater fish consumption advisory due to mercury levels found in fish tissue; the primary source of which is believed to be atmospheric deposition from both in-state and out-of-state sources. When this advisory is included in the assessment, all fresh surface waters are, by definition, less than fully supporting of all uses. Because New Hampshire cannot unilaterally resolve the mercury issue as much of the mercury is not generated in-state, and to provide a more balanced or fair assessment of the State's surface waters, two assessments are provided; one which takes into account the mercury advisory and one which does not. The assessment which does not account for mercury is perhaps more meaningful as it conveys information that would otherwise be masked by the mercury advisory and perhaps more importantly, it represents information for which DES can take corrective action, as needed.

Like other states, New Hampshire has a statewide freshwater fish consumption advisory in effect due to mercury. Because this advisory masks the other water quality issues that DES can directly resolve, two assessments are provided for fresh surface waters; one which includes the mercury advisory and one which does not.

SURFACE WATER ASSESSMENT

OVERALL QUALITY/ USE SUPPORT

Freshwater Rivers and Streams

In New Hampshire there are approximately 10,881.2 miles of rivers and streams, of which approximately 2,677.4 miles (24.6%) were assessed for fishable/swimmable uses. If the statewide freshwater fish consumption advisory due to mercury is not included in the assessment, approximately 2,233.1 miles (83.4 percent) of the assessed rivers and streams fully support all uses, and approximately 444.3 miles (16.6 percent) are either partially or not supporting of one or more uses. With the statewide fish consumption advisory, 100 percent of all freshwater rivers and streams are reported to be less than fully supporting of all uses in accordance with EPA guidance.

Freshwater Lakes and Ponds

Similar to the assessment for rivers and streams, and in accordance with EPA guidance, all freshwater lakes and ponds are reported to be less than fully supporting of all uses because of the statewide freshwater fish consumption advisory due to mercury. Excluding the mercury fish consumption advisory from the assessment, however, shows that in all other respects, the lakes and ponds in New Hampshire are generally in good condition with 153,191 (95%) acres of the 160,590 total assessed acres being fully supportive, 1,123 acres being fully supporting but threatened and 6,276 acres being partially or not supportive of all uses. Approximately 95 percent of the total surface area of all freshwater lakes and ponds in the State were assessed.

Without the mercury advisory

Approximately 24.6% of all freshwater rivers and streams were assessed, of which, approximately 83.4% are fully supporting of all uses. Approximately 95% of all lakes and ponds (by surface area) were assessed of which approximately 96% are fully supporting all uses.

With the mercury advisory

If, however, the statewide freshwater fish consumption advisory due to mercury is accounted for in the assessment, all fresh surface waters are, by definition, less than fully supporting of all uses.

With regards to trophic status of lakes in the State, 29 percent of the 683 significant lakes that were surveyed, representing 75 percent of the 156,002 total acres of surveyed lakes, are classified as oligotrophic (relatively low levels of nutrients and plant productivity). Approximately 48 percent of the lakes, representing approximately 20 percent of the total surface area are mesotrophic (moderate levels of nutrients and plant productivity). The remaining 23 percent of the surveyed lake were classified as eutrophic (relatively high levels of nutrients and plant

5% of the surface area of all surveyed lakes are eutrophic and have relatively high levels of nutrients and plant growth.

productivity). Eutrophic lakes, however, account for only 5 percent of the total surface area.

Of the 697 assessed lakes and ponds, approximately 5 percent experience highly acidic conditions. These lakes, however, are relatively small as they represent only 1.7 percent of the total surface area (156,197 acres) of the assessed lakes. Based on color, the source of acid in these ponds is split approximately 50:50 between acid rain and natural sources in terms of numbers of lakes.

Less than 2% of the surface area of all surveyed lakes are highly acidic.

Tidal Waters

With respect to tidal waters, none of New Hampshire's 18 miles of coastal shoreline waters, 54 square miles of open ocean waters under the State's jurisdiction, or 21.24 square miles of estuaries are fully supportive of all uses. This is because of a bluefish consumption advisory due to concerns with PCBs in fish tissue which impacts all tidal waters and shellfish consumption advisories in the estuaries due to bacteria in the water column and PCB concentrations found in lobster tomalley. The total square miles (sm) of estuaries reported this year (21.24 sm) is less than that reported in previous years (28.2 sm). This new estimate is considered to be more accurate as it is computer generated and based on 1:24,000 scale mapping.

None of the State's tidal waters fully support all uses because of shellfish and bluefish consumption advisories.

*I*NDIVIDUAL *U*SE *I*MPAIRMENT

Primary Contact Recreation / Swimming

In freshwater rivers and streams, approximately 2,657.2 miles (96 percent) of the 2,769.1 miles that were assessed for this use are fully supportive of swimming and 111.9 miles (4 percent) are reported to be less than fully supportive of this use.

Of the 160,406 acres of lakes that were assessed for swimming 158,034 acres (98.5 percent) are fully supporting, 1,085 acres (0.7 percent) are fully supporting but threatened, and 1,287 acres (0.8 percent) are partially or not supporting.

SWIMMING

96% of all assessed freshwater rivers and streams, 99.2% of all assessed lakes, 99.8% of the estuaries, and all open ocean waters fully support swimming.

All open ocean waters and 99.8 percent of the estuaries fully support swimming. Exceptions include North Mill Pond and South Mill Pond in Portsmouth which are impaired due to untreated discharges of sewage from illicit sewer connections and combined sewer overflows respectively.

Aquatic Life Support

If the statewide fish consumption advisory due to mercury is not included in the assessment, 2,558.2 miles (94.3 percent) of the 2,714.1 assessed miles of freshwater rivers and streams, are fully supporting and 155.9 miles (5.7 percent) are reported to be less than fully supporting of the aquatic life use.

Of the 160,570 acres of lakes and ponds that were assessed for aquatic life support, 155,506 acres (96.8 percent) are fully supporting, 54 acres (< 0.1 percent) are fully supporting but threatened and 5,010 acres (3.1 percent) are defined as being partially or nonsupportive of one or more types of aquatic life. Low pH is the major cause of the less than fully supporting rating**.**

All open ocean waters within the State's jurisdiction and 21.08 square miles (99.2 percent) of the estuaries fully support aquatic life. The 0.16 square miles which are categorized as impaired are located in the Lamprey River estuary and are due to occasional exceedances of the water quality criteria for various metals.

Fish Consumption

Excluding the statewide fish consumption advisory due to mercury, all 168,002 assessed acres of freshwater lakes and ponds fully support the fish consumption use. With regard to freshwater rivers and streams, none of the 278.8 miles which were assessed for this use, fully support fish consumption. Approximately 13.4 miles are located on the Androscoggin River, where a fish consumption advisory is currently in effect from Berlin to the State border. The advisory was issued because of dioxin levels found in the tissue of fish. The source of dioxin has since been eliminated. The remaining 265.4 miles are associated with an informational health advisory which has been in effect since 1989 along the main stem of the Connecticut River due to potential concerns with PCBs found in fish tissue. Another study is planned to begin in the summer of 2000 to determine if an advisory is still needed along Connecticut River. If

AQUATIC LIFE SUPPORT AND FISH/ SHELLFISH CONSUMPTION

Freshwaters:

Without the mercury advisory

Approximately 94.3% of the rivers and streams assessed for aquatic life fully support this use, and none of the 278.8 miles of rivers and streams assessed for fish consumption fully support the fish consumption use.

Approximately 96.8% of all assessed lakes and ponds support aquatic life and 100% support fish consumption.

With the mercury advisory

None of the freshwater rivers, streams lakes or ponds support the fish consumption use.

Tidal Waters:

All open ocean waters within the State's jurisdiction and 99.2% of the estuaries fully support the aquatic life use. However, none of the tidal waters fully support the fish consumption use because of a bluefish consumption advisory.

None of the tidal waters fully support shellfish consumption due to either administrative reasons or shellfish advisories issued because of bacteria in the water column or PCBs in lobster tomalley. Progress however is being made to open more shellfish beds currently closed because of bacteria in the water column.

the statewide fish consumption advisory due to mercury is accounted for in the assessment, none of the fresh surface waters are fully supportive of the fish consumption use.

None of the State's tidal waters fully support fish consumption due to a bluefish advisory that was issued in 1987 because of PCB levels in the fish tissue.

Shellfish Consumption

None of the State's 21.24 square miles of estuaries are fully supportive of this use due to either bacteria concentrations in the water column that exceed stringent federal standards or because of a consumption advisory which is in effect due to concerns with PCBs detected in lobster tomalley. Although approximately 14.06 square miles of estuary (66.2 percent) are closed some or all of the time due to bacteria, progress has been made since 1994 with the opening of an additional 3.05 square miles of shellfish beds, of which approximately 0.61 square miles are open on a conditional basis.

The coastal shoreline and open ocean waters within the State's jurisdiction are also closed for recreational shellfish harvesting. This, however, is because a sanitary survey has not been recently conducted in accordance with national shellfish guidelines, and not because of decreased water quality. Once the sanitary survey is completed in 2000, it is expected that most of this area will be opened for shellfishing.

Drinking Water Supply

Rivers, streams, lakes and ponds, which are currently used for drinking water supplies, were assessed for the use of drinking water supply. All are reported to be fully supportive of this use based on State law which requires all such waters to be suitable for drinking after adequate treatment.

All public drinking water supplies fully support the drinking water use.

Secondary Contact Recreation/Agricultural Uses

Though not individually assessed, all fresh and tidal surface waters are considered to be fully supportive of secondary contact recreation. Based on best professional judgement of state surface water quality, all assessed freshwater lakes and ponds and all but 0.5 miles of the assessed freshwater rivers and streams were reported to be fully supportive of agricultural uses. The agriculturally impaired stream segment is located on the site of the former Pease Air Force base and is due to fuel oil found in the surface water.

All surface waters fully support secondary contact recreation.

All assessed lakes and ponds and over 99.9% of the assessed freshwater rivers and streams fully support agricultural uses.

*C*AUSES AND *S*OURCES OF *I*MPAIRMENT

Freshwater Rivers and Streams

(excluding the effects of the statewide freshwater fish consumption advisory due to mercury)

CAUSES	**IMPAIRED MILES**
Metals	306.1 (38 %)
PCBs	265.4 (33 %)
Bacteria	107.9 (13 %)
Siltation / Erosion	56.0 (7 %)
Organic Enrichment/Low D.O	37.7 (5 %)
Dioxin	13.5 (2 %)
Habitat Alterations	11.1 (1 %)
Nutrients	6.0 (<1 %)
Flow Alterations (Low Flow)	5.1 (<1 %)
pH	1.0 (<1 %)
Priority Organics (fuel oil)	0.5 (<1 %)

Without the mercury advisory

Metals, PCBs and bacteria are the leading causes of impairment in freshwater rivers and streams. Miles shown as impaired by cadmium and PCBs are primarily based on levels found in the tissue of fish taken from the Connecticut River in 1988 which constitute all of the miles impacted by PCBs and approximately 81% (248.1 / 306.1) of the miles affected by metals. A fish tissue study scheduled for the summer of 2000 will hopefully determine if these pollutants are still of concern or not. Of the remaing miles impacted by metals and bacteria, follow up investigations are needed, in many cases, to determine if the source is natural and/or if exceedances still exist.

With the mercury advisory

Metals (mercury) is the leading cause of impairment.

SOURCES	**IMPAIRED MILES**
Unknown	642.2 (79 %)
Agriculture (farm animals)	59.0 (7 %)
Combined Sewer Overflows	24.1 (3 %)
Industrial Point Sources	19.1 (2 %)
Urban Runoff	13.4 (2 %)
Municipal Point Sources	11.9 (2 %)
Habitat Modification	11.5 (1 %)
Hydromodification (dams)	11.1 (1 %)
Natural Sources	8.0 (1 %)
Landfills	7.4 (<1 %)
Highway Maintenance/Runoff	1.5 (<1 %)
Recreational/Tourism Activities	1.0 (<1 %)

Without the mercury advisory

The majority of sources are unknown. This, however, is primarily due to the fish studies done on the Connecticut River where the sources of PCBs and cadmium in fish tissue are listed as unknown. The source of these pollutants account for approximately 79.3% of the total miles impaired by unknown sources. Assuming all unknown sources are nonpoint, it is estimated that approximately 91.5% of all sources are nonpoint and 8.5% are point sources.

With the mercury advisory

Atmospheric deposition of mercury is the leading source of impairment.

*C*AUSES AND *S*OURCES OF *I*MPAIRMENT (continued)

Freshwater Lakes and Ponds

(excluding the effects of the statewide freshwater fish consumption advisory due to mercury)

CAUSES	**IMPAIRED ACRES**
pH	5010 (79%)
Exotic Species	800 (13%)
Excessive Algal Growth (chlor a)	425 (7%)
Noxious Aquatic Plants	74 (1%)
Bacteria	18 (<1%)

Without the mercury advisory

The major cause of impairment in freshwater lakes and ponds is low pH values which are probably due to acid rain and the state's natural low alkalinity levels caused by the granitic bedrock.

With the mercury advisory

Metals (mercury) is the leading cause of impairment.

SOURCES	**IMPAIRED ACRES**
Atmospheric Deposition	4958 (79%)
Introduction of Exotic Plants	800 (13%)
Unknown	295 (5%)
Municipal Point Sources (Package Plants)	142 (2%)
Dam Construction	55 (<1%)
Urban Runoff	34 (<1%)
Minor Industrial Point Sources	21 (<1%)
Recreational and Tourism Activites (Heavy Swim Loads)	1 (<1%)

Without the mercury advisory

The major source of impairment in the majority of freshwater lakes and ponds is atmospheric deposition. Over 97% of all impaired acres of lakes and ponds are due to nonpoint sources.

With the mercury advisory

Atmospheric deposition is the leading cause of impairment.

*C*AUSES AND *S*OURCES OF *I*MPAIRMENT (continued)

Tidal Waters

CAUSES	IMPAIRED SQ. MILES
Estuaries	
Polychlorinated biphenyls (PCBs)	21.24 (60%)
Bacteria	14.06 (39%)
Metals	0.16 (<1%)
Open Ocean Waters	
Polychlorinated biphenyls (PCBs)	54.0 (50%)
Unknown (Administrative)	54.0 (50%)
Coastal Shoreline Waters	
Polychlorinated biphenyls (PCBs)	18.0 (50%)
Unknown (Administrative)	18.0 (50%)

PCBs detected in lobster tomalley and bluefish are the leading cause of impairment in all tidal waters. In estuaries, bacteria concentrations that exceed shellfish consumption standards is the next leading cause of impairment.

In coastal shoreline and open ocean waters within the State's jurisdiction, shellfish harvesting is not allowed because sanitary surveys have not been conducted in accordance with national shellfish guidance. Consequently, the cause of these shellfish closures is for administrative reasons and not because of pollutant contamination. A sanitary survey of the New Hampshire Atlantic coastline will be completed in 2000 which is expected to allow most of this area to be opened for shellfishing.

SOURCES	IMPAIRED SQ. MILES
Estuaries	
Unknown	35.42 (99 %)
Sewer Cross Connections	0.03 (<1%)
Combined Sewer Overflows	0.01 (<1%)
Open Ocean Waters	
Unknown	54.0 (50%)
Other (Administrative)	54.0 (50%)
Coastal Shoreline Waters	
Unknown	18.0 (50%)
Other (Administrative)	18.0 (50%)

The source of PCBs and most of the bacteria is listed as unknown as the source of these pollutants cannot be determined with certainty. It is suspected, however, that PCBs are from historical discharges. Illicit sewer cross connections and CSOs are believed to be the primary source of bacteria in North Mill Pond and South Mill Pond respectively.

Sources listed as " administrative" for open ocean and coastal shoreline waters account for the closure of these areas to shellfish harvesting. As discussed above, this was done because of a lack of documentation and not because of a measured decrease in water quality.

*W*ATER QUALITY *T*RENDS

Short-term trends in trophic status were evaluated for 105 lakes having at least five consecutive years of data. Most lakes (80%) showed stable trends while the remaining lakes were split approximately 50:50 between improving and degrading trends.

Short-term trends in trophic status, as collected by volunteer monitors, suggest that most lakes have relatively

*W*ETLANDS

In New Hampshire there are an estimated 7,500 acres of tidal wetlands and 400,000 to 600,000 acres of non-tidal wetlands. Permitted projects and violations over the past two years have impacted less than 0.04 percent of the State's non-tidal wetlands, and there have been no net losses of tidal wetlands. Permitting conditions on major projects (more than 20,000 square feet of freshwater wetlands or any amount of tidal wetlands) are designed to assure that there has been no significant net loss of wetlands function.

Over the past two years, less than 0.04 percent of all wetlands were impacted. Monitoring and enforcement of permit requirements have been expanded to assure compliance with permitting conditions, including the mitigation of unavoidable impacts.

An independent study of the State's permitting and mitigation practices published in July, 1997 by the Audubon Society of New Hampshire confirms the State's low level of wetlands loss, but found that a portion of the required mitigation for permits issued during 1995 was not completed. In response the State has strengthened its permitting conditions, expanded its permit monitoring and enforcement activities, and is continuing to actively pursue violations of permit conditions.

In 1992, New Hampshire became the first state to be issued an inclusive statewide programmatic general permit by the U.S. Army Corps of Engineers that eliminates federal reliance on Nationwide general permits. The New Hampshire State Programmatic General Permit (NHSPGP) was reissued in June 1997, and continues to serve as a model that other states strive to match. The NHSPGP will be up for renewal in 2002, and DES continues to work with federal agencies to improve the process even further.

*P*UBLIC *H*EALTH / *A*QUATIC *L*IFE *C*ONCERNS

Based on in-stream concentrations, toxics do not appear to be a major problem in New Hampshire surface waters. Certain bioconcentratable toxics found in fish tissue however, have warranted fish consumption

Toxics: Based on in-stream concentrations

and limited biomonitoring information, toxics do not appear to be a major problem in New Hampshire surface waters. Approximately 3% of the assessed lakes and ponds, 6% of the assessed rivers and streams, and less than 1% of the estuaries exhibited concentrations of toxics in the water column that exceeded water quality criteria for the protection of aquatic life. In certain lakes, low pH due to acid rain and natural sources is the main toxic whereas potentially toxic metal concentrations were measured in some rivers and estuaries. Based on fish consumption advisories and the level of certain bioconcentratable toxics found in the tissue of fish, the potential risk to public health posed by some toxics is more of a concern. This is discussed in the following section.

Fish Consumption Advisories: Like many of the other New England States, there is a statewide fish consumption advisory in effect in New Hampshire for freshwater fish due to mercury levels found in the fish tissue. There is also a separate fish consumption advisory for largemouth bass taken from Horseshoe Pond in Merrimack due to mercury. Along portions of the Androscoggin River, a fish consumption advisory is in effect due to dioxin and along the main stem of the Connecticut River, an informational health advisory has been issued because of PCB levels found in fish tissue. On the coast, consumption advisories have been issued for bluefish (all tidal waters) and for lobster tomalley (taken from estuaries north and west of Rye Harbor) due to polychlorinated biphenyls (PCB) levels.

In New Hampshire, there are currently six fish consumption advisories in effect which includes a statewide advisory for all freshwater fish due to mercury.

The primary source of mercury is believed to be from atmospheric deposition with municipal waste incinerators estimated to be the largest source of mercury in the Northeast. In 1997, EPA released the "Mercury Study Report to Congress", to help states plan for mercury mitigation (USEPA, 1997b). In February of 1998 a report was issued by the Northeast States and Eastern Canadian Provinces, which took a regional look at the sources, transport and deposition, impacts, and ways to reduce mercury pollution. In New Hampshire, a state level mercury reduction strategy was drafted and released in October, 1998. The strategy contains 40 recommended actions to reduce mercury releases in New Hampshire, including those from medical and municipal waste incineration and power generation. Implementation of the strategy is expected to result in a 50% reduction in mercury releases by 2003, with a long-term goal of the virtual elimination of mercury releases. Legislation passed in 1999 imposes a stringent mercury emissions limit on the State's largest municipal combustor. New Hampshire is also participating in an effort to led by the New England Governors Conference and the Eastern Canadian Premiers to implement the Regional Mercury Action Plan, adopted by the Governors and Premiers in 1998.

On the Androscoggin River, the primary source of dioxin has been virtually eliminated due to process changes at the Pulp and Paper of America paper mill in Berlin. With regard to PCBs, it is believed that the major source is from historical discharges since production of PCBs was banned in the United States in the 1970s.

***Shellfishing Advisories due to Bacteria*:** Approximately 14.06 square miles (sm) or 66.2% of the State's 21.24 sm of estuaries remain closed some or all of the time. The closures are either due to measured bacterial levels in the water column that exceed stringent bacterial standards established by the U.S. Food and Drug Administration for waters where shellfish are harvested for consumption or because data is lacking that would allow the beds to be opened in accordance with federal shellfishing guidelines. Though the majority of beds remain closed, progress has been made in opening more beds. Since 1994, an additional 2.44 sm (11.5%) of estuaries in Upper and Lower Little Bay have been opened for shellfishing and another 0.61 sm (2.9%) in Hampton Harbor were conditionally opened which means that during dry weather the beds are open but when it rains significantly, the Hampton Harbor beds are closed for five days. In all, shellfishing is now allowed in 7.79 sm (36.7 %) of the estuaries some or all of the time, with 7.18 sm (33.8%) being opened unconditionally and 0.61 sm (2.9%) being open on a conditional basis (i.e., open during dry weather but closed after significant rain storms). The total area of estuaries and percentages that are open and closed to shellfishing differ from the 1998 report due to more accurate methods of measuring estuarine areas. Efforts continue to open more beds by identifying and eliminating major sources of bacteria and acquiring the information needed to fill data gaps to satisfy federal shellfishing guidelines.

Although progress is being made to open more shellfish beds, 66.2% of the State's estuaries are closed for shellfishing harvesting some or all of time. The beds are closed because of possible bacterial contamination or because there is insufficient data to allow the beds to be opened in accordance with federal shellfishing guidelines.

***Drinking Water Restrictions*:** During this reporting period there were no documented incidents of waterborne diseases and only one short-term surface drinking water supply restriction (boil order) was issued due to bacteria. The source of bacteria, however, is not believed to be from a polluted surface water supply as most if not all surface water supplies contain bacteria levels that exceed Safe Drinking Water Act standards. Rather, inadequate disinfection of the source water or the distribution system due either to mechanical or operator failure is believed to be the reason why bacteria was detected and the boil order had to be issued.

GROUNDWATER ASSESSMENT

New Hampshire is highly dependent on groundwater for drinking water. Groundwater is found in both overburden and fractured bedrock aquifers. Highly productive stratified drift aquifers are found scattered throughout the State. Natural groundwater quality from stratified drift aquifers is generally good, however, this water can be impacted by such aesthetic concerns as iron, manganese, corrosiveness, taste and odor. Bedrock well water quality is also generally good although this water

Groundwater quality in New Hampshire is generally good although there are localized areas of degraded groundwater from human activity.

can be impacted by naturally occurring contaminants including fluoride, arsenic, mineral radioactivity and radon gas. Elevated concentrations of radon gas occur frequently in bedrock wells.

In addition to naturally occurring contaminants, there are many areas of localized contamination due primarily to releases of petroleum and volatile organic compounds from petroleum facilities, commercial and industrial operations and landfills. Of particular concern recently are detections of MTBE, a gasoline additive, in public and private wells. Many of these detections appear to be associated with usage of small amounts of gasoline by homeowners rather than leaking underground storage tanks or commercial operations. Due to widespread winter application of road salt, sodium is also a contaminant of concern in New Hampshire groundwater. All contaminated sites are located in the DES Geographic Information System (GIS). Although localized contamination continues to be discovered in New Hampshire, particularly from leaking underground storage tank sites, the State has made steady progress in remediating sites with contaminated groundwater.

Recently, groundwater availability issues are of increasing concern, particularly in southern and southeastern New Hampshire. This concern has led to the passage of legislation that requires that any adverse impact to surrounding water resources from a large groundwater withdrawal be identified and mitigated.

New Hampshire continues to involve all stakeholders in identifying and addressing groundwater protection issues. The second five-year workplan to improve groundwater protection in partnership with stakeholders is under development, having successfully completed a number of important initiatives during the last five years.

WATER POLLUTION CONTROL PROGRAM

POINT SOURCE CONTROL PROGRAM

Major components of New Hampshire's point source control program include the state and federal discharge permit process, New Hampshire's CSO strategy, the industrial pretreatment program, the compliance process and the wastewater treatment plant technical assistance program, all of which serve to control point source discharges into New Hampshire's surface waters.

All major wastewater treatment facilities designed to eliminate dry weather discharges of

Since passage of the CWA in 1972, it is estimated that approximately $838 million of local, state and federal funds have been spent on water pollution control facilities. As a result, all major wastewater treatment plants, which were designed to eliminate dry weather discharges of untreated municipal and industrial wastewater, have been built.

NONPOINT SOURCE (NPS) CONTROL PROGRAM

Since the nonpoint source program was established in 1988, a management plan was adopted in 1989 and updated in 1999, a grants program began in 1990, BMPs have been developed, and in some cases, incorporated into law, point source discharges have been cleaned up, and more public attention has been given to nonpoint source pollution. State, as well as federal agencies, are placing more emphasis on nonpoint source and watershed management.

With most point sources under control, abatement of nonpoint sources (NPS) is now the focus of attention with urban runoff being the main NPS issue of concern.

In 1999, DES began using federal funds allocated for restoration of water resources impacted by nonpoint source pollution. The "incremental" Section 319 funds are to be used primarily for on-the-ground restoration improving water resources that are not currently meeting water quality goals. Restoration projects are under way in each "Category I" watershed, as identified in the *Unified Watershed Assessment*. In March 2000, DES hired a coordinator for the Coastal/Piscataqua River watershed to facilitate restoration efforts and to assist local watershed management organizations.

DES continues its nonpoint source investigation program whereby NPS program staff conduct field investigations watershed by watershed to identify NPSs and to work toward their abatement. Field work continues in the coastal watershed, where numerous sewer cross-connections have been found and repaired. When the initial round of investigations is completed in the coast, investigations will begin in the Merrimack basin. .

DES, through its many partnerships, will continue to expand and improve upon its watershed management efforts. Federal grants in support of these efforts are expected to increase substantially, allowing DES to have a greater presence in local watershed management and to provide greater technical and financial assistance to such efforts. As urban runoff remains in the forefront of NPS issues, "smart growth" initiatives will become increasingly important in our efforts to accommodate growth while protecting and enhancing environmental resources.

SPECIAL STATE CONCERNS

Major surface water quality related concerns in the State include the following:

* Resolving the following point source issues:

Upgrading the Somersworth, Rollinsford, Rochester, Epping, Jaffrey, Peterborough and Monadnock Paper Company WWTFs to provide advanced treatment to ensure that they meet water quality standards for dissolved oxygen;

Abating pollution from the 46 remaining CSOs in New Hampshire. To expedite implementation of CSO abatement plans, which is estimated to cost over $200 million, federal funding assistance is needed;

Reissuing NPDES permits for approximately 100 "minor" facilities to ensure that they are meeting current water quality standards.

Special concerns include:

Upgrading seven WWTFs,
Abating CSOs,
Reissuing "minor" NPDES permits,
Nonpoint source pollution
Opening more shellfish beds,
Mercury in freshwater fish,
Biomonitoring,
Non-native aquatic species,
Federal funding for existing programs and programs such as TMDLs and comprehensive surface water monitoring strategies.

* Identification, abatement and prevention of nonpoint sources of pollution including 1) assisting communities in complying with Phase II of the federal NPDES permitting requirements for stormwater, 2) institutionalizing land protection support capability through the regional planning commissions, and 3) improving protection of riparian buffers through land protection, education and outreach, and land use regulations.

* Opening more shellfish beds that are currently closed due to bacterial contamination or because data is lacking that would allow the beds to be opened in accordance with federal shellfishing guidelines.

* Identification and implementation of solutions to the statewide freshwater fish consumption advisory due to mercury. Since atmospheric deposition is the major source of mercury to surface waters, and since a substantial portion of the mercury deposited in NH originates outside the state, the reduction in mercury releases to the environment needs to be addressed at both the state, regional and national levels. New Hampshire drafted a state level mercury reduction strategy in 1998 and, on a regional level, is participating in an effort led by the New England Governors Conference and the Eastern Canadian Premiers, to implement the Regional Mercury Action Plans, adopted by the Governors and Premiers in 1998.

* Continuing the biomonitoring program initiated in 1995, to complement existing chemical and physical water quality information. To accomplish this, federal funds will be needed.

* Preventing the spread of zebra mussels into state waters and reducing the spread of non-native plant species such as milfoil and fanwort are major concerns of the State.

* Maintaining federal funding levels for essential water pollution control programs to prevent the degradation of surface waters and to protect the hundreds of millions of dollars already invested to achieve the current high water quality in New Hampshire. Additional federal funds are also needed to meet the federal requirements and/ or goals of the Total Maximum Daily Load (TMDL) and comprehensive surface water monitoring programs.

PART II

BACKGROUND

PART II, CHAPTER 1

WATER RESOURCE ATLAS

While New Hampshire is not a large state in terms of land area or population, it is fortunate to have numerous lakes, ponds, rivers, streams, and estuaries. Though its coastline is limited, its tidal embayments are extensive. With an average of 40 inches of rainfall fairly evenly distributed throughout the year, New Hampshire's surficial aquifers are regularly replenished.

Table II-1-1 provides a general overview of basic hydrologic data for New Hampshire. As shown on Figure II-1-1, the State is divided into six major water basins: the Androscoggin, Coastal, Connecticut, Merrimack, Piscataqua and the Saco/Ossipee River basins.

The estimated number and acres of lakes, ponds and reservoirs shown on Table II-1-1 are based on United States Environmental Protection Agency's (EPA) 1993 estimate of total waters. The estimated miles of rivers and streams are the same as reported in the 1998 305(b) Report, which are based on EPA's 1991 estimate of total river and stream miles, as amended by the New Hampshire Department of Environmental Services (hereinafter referred to as DES or the Department). The primary reason for using the 1991 amended estimate instead of the 1993 estimate was because significant discrepancies were found in the backup data used to compute the 1993 totals for river and streams. These discrepancies have not yet been resolved. It was therefore decided to use the 1991 amended estimate which is considered to be the most reliable estimate at this time.

As discussed in Part III, Chapter 5 (Section 5.2.1), some inconsistencies have also been found between EPA's 1993 estimate of lakes, ponds and reservoirs and DES's data base. The number and acreage of lakes, reservoirs and ponds reported on Table II-1-1 are based on EPA's 1993 estimate whereas the number and size of significant publicly owned lakes, reservoirs and ponds is from the DES Biology Bureau's database. As acknowledged in Section 5.2.1, more work needs to be done to reconcile differences between the two databases.

EPA's estimate of total waters is based on a scale of 1:100,000. Work is currently underway, however, at the University of New Hampshire Complex Systems to develop centerline for all rivers and streams in New Hampshire at a scale of 1:24,000. When completed (by 2001), DES expects to use the 1:24,000 scale information to develop more accurate estimates of total river / stream miles in the State.

With regard to the estuaries, a value of 21.24 square miles is reported this year versus 28.2 square miles in previous reports. This new estimate was computer generated by the New Hampshire Office of State Planning (NHOSP) and is based on 1:24,000 mapping. As such, it is considered to be a more accurate and representative estimate of the actual estuarine area and was therefore used in this report.

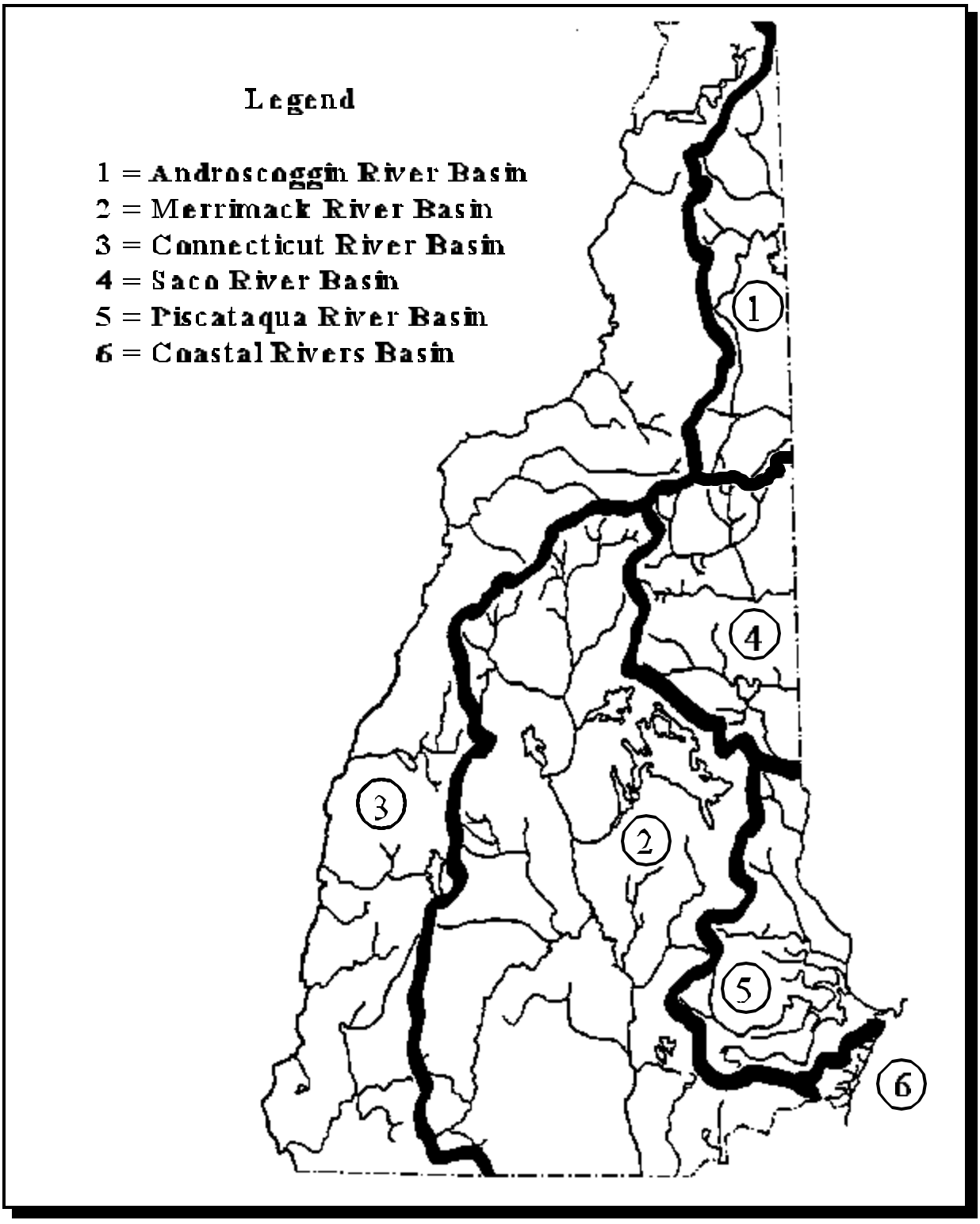
Table II-1-1
Surface and Groundwater Atlas

Topic	Value
Surface Water Atlas	
State population as of July, 1999	1,201,134
Square miles of surface are	9,304
Number of major water basin	6
Total miles of rivers and streams[3]	10,881
Miles of perennial rivers/streams[3]	8,636
Miles of intermittent streams[3]	2,238
Miles of ditches and canals[3]	7
Border miles of shared rivers/streams[5]	310
Number of lakes/reservoirs/ponds[4]	1,708
Number of significant publicly owned lakes/reservoirs/ponds[6]	698
Acres of lakes/reservoirs/ponds[4]	163,033
Acres of significant publicly owned lakes/reservoirs/ponds[6]	156,212
Square miles of estuaries[1]	21.24
Miles of ocean coast[2]	18
Acres of freshwater wetlands[7]	400,000
Acres of tidal wetlands[7]	7,500
Groundwater Atlas[8]	
State population served by groundwater supplies	720,000
Number of community wells	1,222
Number of transient non-community wells	1,197
Number of non-transient/non-community wells	538
Number of private potable wells	180,000

Footnotes

1. NH Office of State Planning estimate based on 1:24,000 scale U.S. Geological Survey maps.
2. DES estimate based on 1:24,000 scale U.S. Geological Survey maps.
3. Based on EPA's "Total State Waters: Estimating River Miles and Lake Acreages for the 1992 Water Quality Assessments (305(b) Reports), December, 1991, as amended by DES. Estimates are based on 1:100,000 scale U.S. Geological Survey maps.
4. Based on EPA's, "Total Waters Database Reporting Program", Version 1.1, October, 1993, which is based on 1:100,000 scale, U.S. Geological Survey maps.
5. DES estimate of river miles for the Connecticut River, Halls Stream, the Salmon Falls River and the Piscataqua River.
6. From the DES Biology Bureau, 1998; see Part III, Chapter 5.
7. From the DES Wetlands Bureau, 1993; see Part III, Chapter 7. Estimates are based on interpretation of LANDSAT Telemetry Data.
8. From the DES Groundwater Protection Bureau, 1999; see Part IV.

Figure II-1-1
New Hampshire River Basins



PART II, CHAPTER 2

WATER POLLUTION CONTROL PROGRAMS

2.1 INTRODUCTION

This chapter provides an overview of the Department's approach to water quality management. First discussed is the "Watershed Approach" which was initiated to address remaining water quality concerns. This is followed by a review of the State's water quality standards, which set forth the goals of the water quality program. In the last two sections, an overview of the State's point source and nonpoint source (NPS) control programs is provided.

2.2 WATERSHED APPROACH

The 1987 amendments to the Clean Water Act (CWA), required states to expand their programs for dealing with issues such as toxicants, nonpoint sources (NPS), wetlands and water quality standards. Progress made over the past 25 years in abating point source pollution has revealed that NPS pollution accounts for most of the remaining water quality problems. Solutions to NPS problems, require a broader approach which addresses all human activities within a watershed which could be contributing to the problem.

To address these issues, a watershed management approach for point and nonpoint sources was initiated in 1995. To facilitate the watershed approach, DES created the Watershed Management Bureau (WMB) in 1999. The WMB was formed by merging the Surface Water Quality Bureau, whose responsibilities included rivers and streams and tidal waters, and the Biology Bureau, whose focus is on lakes and ponds. By doing so, personnel responsible for maintaining the quality of all types of surface waters are now together in one bureau.

As an overall framework for the watershed management program, the State has been divided into the following five management areas shown below. For more effective local watershed management, however, these basins are further subdivided into smaller sub-basins or watersheds.

1. Coastal/Piscataqua
2. Upper Merrimack
3. Lower Merrimack
4. Connecticut
5. Saco and Androscoggin

As discussed in Part III, Chapter 1, DES initiated a rotating watershed monitoring program in 1989. With regard to point source management, permits for point source dischargers are issued, facilities are inspected, and enforcement actions (if necessary) are taken, wherever possible, on a watershed basis.

With regard to nonpoint source control efforts, the long-term plan is to have a coordinator in each major river basin to facilitate restoration activities and work with local watershed management organizations. In general, the watershed program relies on both state actions and local leadership such as a watershed association, regional planning commission, conservation district, municipality, business group, or water supplier. Deciding local watershed priorities is the responsibility of the lead organization. Where needed, however, DES will assist the local watershed organization with defining its goals and setting priorities to address water quality problems. To direct their actions, watershed organizations may develop a watershed management plan or adopt a more informal, targeted approach to problem solving.

Since 1996, DES has focused its efforts on the Coastal/Piscataqua River basins where DES nonpoint source staff have been busy identifying and abating NPS pollution and providing local initiatives grants for NPS projects. Basin investigations are anticipated to remain in the coastal watershed through the 2000 field season. When initial coastal watershed investigations are completed, staff will move to the Merrimack watershed where their efforts will focus on identified issues, including assistance to NPDES Stormwater Phase II communities, bank erosion, and water quality problems identified on the 303(d) List of impaired waters.

In March 2000, DES hired a Coastal Watershed Coordinator who will remain in the Coastal watershed to continue clean-up efforts and to assist local watershed management organizations where needed. Depending on the availability of resources, DES intends to hire a coordinator for the Merrimack River Basin next.

DES will continue to support land protection activities, smart growth initiatives, and riparian area management in addition to restoration activities to comprehensively address watershed management. More information about the Watershed Management and Local Initiatives Grants Programs is provided in Section 2.5.2.

2.3 WATER QUALITY STANDARDS

2.3.1 Overview

Water Quality Standards determine the baseline quality that all surface waters of the State must meet in order to protect their intended uses. They are the "yardstick" for identifying where water quality violations exist and for determining the effectiveness of regulatory pollution control and prevention programs. The standards are composed of three parts: the classifications, the criteria, and the antidegradation regulations. Each of these components are discussed below.

2.3.2 Waterbody Classifications

The process of classifying New Hampshire surface waters began in 1948 when the Water Pollution Commission (which is now the Water Division of DES) held hearings and petitioned the State Legislature to classify the Ammonoosuc River. Classification of surface waters is now accomplished by state legislation under the authority of RSA 485-A:9 and RSA 485-A:10. By definition, (RSA 485-

A:2, XIV), "surface waters of the state means perennial and seasonal streams, lakes, ponds, and tidal waters within the jurisdiction of the state, including all streams, lakes, or ponds, bordering on the state, marshes, water courses and other bodies of water, natural or artificial"and include waters of the United States as defined in 40 CFR Part 122.2. In accordance with procedure, DES may, by itself, or upon petition by at least 100 legal inhabitants of the county or counties in which the surface water in question is situated, recommend reclassification to the legislature.

Prior to 1991, there were three classifications, A, B and C which had the following general meanings:

Class A - These are generally of the highest quality and are considered potentially usable for water supply after adequate treatment. Discharge of sewage or wastes is prohibited to waters of this classification.

Class B - Of the second highest quality, these waters are considered acceptable for fishing, swimming and other recreational purposes, and, after adequate treatment, for use as water supplies.

Class C - These waters were the third highest category and were considered adequate for fishing, boating, and certain industrial uses. As discussed below, the state upgraded all Class C waters to Class B in 1991.

During the 1991 session of the General Court, a significant legislative event occurred when HB 560-FN was passed which reclassified and upgraded all remaining Class C waters to Class B. When this bill was signed into law and became effective on August 31, 1991, a new State goal was established to have all the surface waters of the State achieve the fishable/swimmable goals of the Clean Water Act. A copy of HB 560-FN is included in Appendix A.

As of 1991, all State surface waters now have either a Class A or Class B classification, with the majority of waters being Class B. DES maintains a list which includes a narrative description of all the legislative classified waters. Since passage of HB 560 in 1991, no additional waterbodies have been reclassified.

2.3.3 Water Quality Criteria

The second major component of the water quality standards is the "criteria". These are numerical or narrative criteria which define the water quality requirements for Class A or Class B waters. Criteria assigned to each classification are designed to protect the legislative designated uses for each classification. A waterbody that meets the criteria for its assigned classification is considered to meet its intended use.

Water quality criteria for each classification may be found in RSA 485-A:8, I-V and in the State of New Hampshire Surface Water Quality Regulations (Env-Ws 1700), a copy of which may be found in Appendix A. Of special note, is that upon passage of HB 560-FN in 1991, Class B waters

now have two sets of criteria. In most cases, standard Class B criteria apply. However, there are times, as explained below, when Temporary Partial Use (TPU) criteria is allowed.

As indicated in RSA 485-A:8, II and III (see Appendix A) and as shown in Table II-2-1, the primary differences between standard Class B criteria and TPU criteria relate to pH, dissolved oxygen and bacteria. TPU criteria may apply in surface waters that receive discharges from combined sewer overflows (CSOs). According to RSA 485-A:II, and III, TPU criteria shall apply during CSO discharges and up to three days following cessation of the CSO(s), where it is demonstrated to the satisfaction of DES that standard Class B criteria cannot be reasonably met at all times as a result of CSOs. At the present time, there are no surface waters in the State which are designated as TPU because of CSOs.

When HB 560-FN was passed in 1991, it also stated that TPU could apply in surface waters that receive effluent from existing municipal wastewater treatment facilities (WWTFs) during certain low river flow conditions. This section of the law however was eliminated upon passage of HB 1155 in the 1997/1998 Legislative session as it was not consistent with federal Clean Water Act.

Table II-2-1
Major Differences Between Class B and TPU Water Quality Criteria

Parameter	Class B Criteria	TPU Criteria
pH	6.5 - 8.0	6.0 - 9.0
Dissolved Oxygen	Minimum average daily percent DO saturation of 75%. Minimum instantaneous DO concentration of 5 mg/L.	Minimum DO concentration of 5.0 mg/l
Bacteria	Escherichia coli limits for freshwater; Enterococci limits for ocean (swimming); Total or Fecal Coliform limits for shellfish areas.	No bacteria limit

In summary, it is important to understand that if certain conditions are met, it is possible for some Class B waters, which are impacted by CSOs, to have two sets of water quality criteria. Under certain conditions and for limited periods of time, TPU criteria would apply, while at all other times, standard Class B criteria would apply. As previously mentioned, there are currently no TPU designated surface waters in the State.

DES revised its surface water regulations (see Appendix A) on December 10, 1999. Major changes to the regulations in 1999 included an update of the metals criteria and modification of the entire antidegradation provisions to clarify its intent and make it more consistent with other New England states. The metals criteria was based on EPA's latest criteria contained in the December 10th Federal Register. Antidegradation is discussed in the following section.

2.3.4 Antidegradation

The purpose of having antidegradation provisions in water quality standards is to preserve and protect the existing beneficial uses of the State's surface waters and to limit the degradation allowed in receiving waters. Antidegradation regulations are included in Env-Ws 1708.08 to 1708.12 of the New Hampshire Surface Water Quality Regulations (see Appendix A).

According to Env-Ws 1708.02, antidegradation applies to the following:

* Any proposed new or increased activity, including point source and nonpoint source discharges of pollutants, that would lower water quality or affect the existing or designated uses;
* A proposed increase in loading to a waterbody when the proposal is associated with existing activities;
* An increase in flow alteration over an existing alteration; and
* All hydrologic modifications such as dam construction and water withdrawals.

The regulations include specific steps that DES will follow to make a decision regarding antidegradation in Class A, Outstanding Resource, and High Quality Waters. For all surface waters, however, the existing uses and water quality necessary to sustain the existing uses must be maintained and protected (Env-Ws 1708.04). Where it is necessary to show the relative impact of the proposed discharge on existing water quality, Env-Ws 1708.08 includes procedures which must be followed to determine this.

Class A Waters: Pursuant to RSA 485-A:8, I, discharges containing "sewage" or "wastes" (as defined in RSA 485-A:2, X and RSA 485-A:2, XVI) are not allowed in Class A waters. Consequently , degradation of Class A waters is prohibited. However, if the discharge does not contain sewage or wastes, and if it can be shown that the proposed discharge will not raise the concentration of the parameters in the receiving water or lower the dissolved oxygen, the discharge application will not be denied based on antidegradation (Env-Ws 1708.06).

Outstanding Resource Waters (ORW): ORWs include waters of the national forests and waters designated as "natural" under the States' River Management and Protection Program. In these waters, degradation is prohibited except that some limited point and nonpoint source discharges may be allowed provided that they are of limited activity which results in no more than temporary and short term changes in water quality. "Temporary and short term" mean that degradation is limited to the shortest possible time. Such activities shall not permanently degrade water quality or

result at any time in water quality lower than that necessary to protect the existing and designated uses in the ORW. Such temporary and short term degradation shall only be allowed after all practical means of minimizing such degradation are implemented (Env-Ws 1708.05).

High Quality Waters: In High Quality Waters it is first necessary to determine if the discharge is "insignificant" or "significant" (Env-Ws 1708.09). Insignificant discharges include the following:

* Short term or intermittent discharges from activities such as:

  Hydrostatic testing of pipelines;
  Fire pump test water;
  Uncontaminated stormwater discharges; or
  Site cleanup activities;

* Permanent discharges such as:

  Uncontaminated noncontact cooling water;
  Uncontaminated groundwater seepage; or
  Unchlorinated or dechlorinated swimming pool water.

* Facilities whose nonpoint source runoff is controlled through the use of best management practices; and

* Any discharge or activity that is projected to use less than 20 percent of the remaining assimilative capacity for a water quality parameter, in terms of either concentration or mass of pollutants.

If DES determines that, because of the following factors, the effects of a discharge results in a greater impact to the water quality than that normally found in insignificant discharges, it shall determine that the proposed activity is significant, regardless of the proposed consumption of the remaining assimilative capacity, and require the applicant to demonstrate, in accordance with Env-Ws 1708.10 that a lowering of water quality is necessary to achieve important economic or social development:

(1) The magnitude, duration and spacial extent of the proposed change in water quality;

(2) The cumulative lowering of water quality over time resulting from the proposed activity in combination with previously approved activities;

(3) The possible additive or synergistic effects of the activity in combination with existing activities;

(4) The magnitude of the mass load independent of the total assimilative capacity or change in receiving water pollutant concentration;

(5) The toxic or bioaccumulative characteristics of the pollutant(s) in question;

(6) The potential to stress sensitive biological resources such as indigenous species, rare species, and threatened or endangered species and their habitat;

(7) The potential to stress sensitive recreational uses or water supply uses; or

(8) The quality and value of the resource.

Where a discharge is determined to be "insignificant" and does not pose a threat to public health or safety or the environment, the discharge application can proceed and will not be denied based on antidegradation.

If a discharge is not "insignificant", it is considered to be "significant". Significant dischargers must demonstrate that the (1) proposed project or activity will provide an important economic or social development in the area where the waterbody is located, and (2) lowering of water quality is necessary to accommodate the development. Regulations explaining how to determine if the lowering of water quality is necessary to accommodate the development are covered in Env-Ws 1708.10(c).

Regulations explaining how to demonstrate economic or social development are covered in Env-Ws 1708.10(b). These requirements apply to all significant discharges as well as insignificant discharges that pose a threat to public health or safety or the environment.

Public participation requirements are included in Env-Ws 1708.11. DES shall issue written notice to the public (i.e., through the local newspaper), the intergovernmental review coordinator, and the municipality in which the facility is located or proposed. The notice shall include the following:

(1) a description of the proposed activity;

(2) a description of the surface waters involved and their use classification;

(3) a statement of the department's antidegradation provisions;

(4) a determination that existing uses and necessary water quality will be maintained and protected;

(5) a summary of the expected impacts on high quality waters;

(6) a determination that where a lowering of water quality is allowed, all applicable water quality criteria shall be met, designated uses protected, and any higher water quality achievable by the most stringent applicable technology-based requirements shall be maintained;

(7) a discussion of any other information that is relevant to how the activity

complies or does not comply with these provisions;

(8) a summary of the important economic or social development, if applicable;

(9) a summary of the alternatives analysis and a finding that the lowering of water quality is necessary;

(10) the name, address, and telephone number of the person in the department where all written comments or requests for public hearing can be sent.

Once all public comment is received and/or after a public hearing is held, a decision is made by DES as to whether limited degradation is warranted and if the discharge or activity should be allowed.

2.3.5 Toxic Substances

In general, substances in toxic quantities or combinations are prohibited from being discharged to the State's waters. Specifically Env-Ws 1703.21 states that unless naturally occurring or allowed in mixing zones, all classes of waters shall be free from toxic pollutants or chemical constituents in concentrations or combinations that:

a. Injure or are inimical to plants, animals, humans or aquatic life; and
b. Persist in the environment or accumulate in aquatic organisms to levels that result in harmful concentrations in edible portions of fish, shellfish, or other aquatic life, or wildlife which may consume aquatic life.

The determination of toxicity is made by comparison with surface water criteria published in the State's Surface Water Quality Regulations (Appendix A) or on the basis of site specific determinations or biotoxicity. Acceptable procedures for determination of biotoxicity include the utilization of indicator species such as fathead minnows or other species, as appropriate, under controlled conditions utilizing standard methods to determine chronic and acute toxicity responses to the proposed discharge. These biotoxicity analyses are commonly called whole effluent toxicity (WET) tests. In addition to WET tests, in-stream biomonitoring data, as it becomes more available in the future, should also provide valuable information regarding the toxicity of surface waters in New Hampshire.

2.3.6 Revisions To Water Quality Standards

In accordance with the Clean Water Act (CWA), water quality standards are reviewed and revised, as necessary, at least every three years. Statutory authority to create (or revise) the water quality standards is provided under RSA 485-A:6 and RSA 485-A:8. Any new rules or changes to rules must be adopted in accordance with RSA 541-A, which first requires a public hearing.

The last complete triennial review and update of the standards recently occurred in 1999. Revisions were made to the New Hampshire Surface Water Regulations (formerly Env-Ws 430, now Env-Ws 1700), which became effective on December 10, 1999.

2.4 POINT SOURCE CONTROL PROGRAM

2.4.1 Introduction

The Clean Water Act of 1972 provided much of the impetus for the water pollution abatement effort of the last two decades. With associated federal, state and local funding, involving the earlier Construction Grants Program, the current Revolving Loan Program, as well as the National Municipal Policy (NMP) program, significant progress in abating pollution from point sources was made and concomitant improvements in New Hampshire surface water quality was noted. The construction of industrial and municipal wastewater treatment facilities (WWTF) initially focused on technology-based controls and on conventional pollutants. With the completion of the upgrade of the primary plants to secondary treatment and with the elimination of all known dry weather raw municipal discharges, New Hampshire has shifted emphasis to water quality-based controls and to the control of toxic pollutants.

The following is an overview of the major components comprising New Hampshire's point source control program. First discussed in Section 2.4.2 is the discharge permit process which is the primary vehicle used to control and prevent point source discharges from violating water quality standards. In Section 2.4.3, New Hampshire's strategy for abating pollution from combined sewer overflows (CSOs) is discussed. Another important component is the industrial pretreatment program, the purpose of which is to control the pollutants that industries discharge to municipal WWTFs so that the pollutants do not pass through or interfere with the treatment processes at the WWTF or contaminate the sewage sludge; this is discussed in Section 2.4.4. The methods used to ensure compliance of point sources with water quality standards is covered in Section 2.4.5. Section 2.4.6 includes a review of the technical assistance program provided by DES to keep treatment plants operating as efficiently as possible. This is becoming increasingly important as many facilities are nearing their design life. Presented last, in Section 2.4.7, is a review of recent work done in each river basin to control point source discharges in New Hampshire.

2.4.2 Discharge Permits

The primary means of regulating point sources in New Hampshire is through the discharge permit process. Since the State is not "delegated," EPA is responsible for implementing the NPDES (National Pollutant Discharge Elimination System) permit process in accordance with Section 402 of the Clean Water Act (CWA). As a rule, the State works closely with EPA to establish appropriate discharge limits. Prior to issuance of the NPDES permit, the State must certify that the permit meets State water quality laws and regulations.

In accordance with RSA 485-A:13 and Env-Ws 401, dischargers are also required to obtain a State Discharge Permit. In most cases, the NPDES permit serves as the State Discharge Permit. In such cases, and after the NPDES permit is issued, DES sends a letter to the discharger informing them that their NPDES permit is also their State Discharge Permit. In this manner, the permittee only has one set of discharge limits to comply with.

Permits are generally issued for five years. In New Hampshire there are presently a total of 83

municipal and 90 active industrial permits. Of these, 42 are categorized as major municipal facilities and 24 are considered to be major industrial facilities. EPA and the State are working very diligently to try and reissue all of the major permits by September 30, 2000 and the minor permits by the end of the federal fiscal year 2003.

RSA 485-A:8, I-IV and the State Surface Water Quality Regulations (Env-Ws 1700) are the primary references used to develop permit effluent limits. Where toxics are a concern, specific permit limits, based on the chemical specific criteria in the Surface Water Quality Regulations, are set for those toxics in the permittee's effluent which may cause water quality violations. To further prevent toxic discharges, most permits also include a requirement to perform whole effluent toxicity (WET) tests to determine if the combined effect of all substances in the discharge are potentially toxic to aquatic organisms in the receiving water.

2.4.3 Combined Sewer Overflow (CSO) Strategy

Combined sewer overflows (CSOs) are point source discharges and, therefore, are also regulated under the NPDES and State discharge permit system. In New Hampshire, there are 46 CSOs located in the communities of Manchester, Nashua, Lebanon, Portsmouth, Berlin, and Exeter. The NPDES permit for each community requires that they develop plans to determine the impact of CSOs on water quality and to implement certain best management practices (BMPs).

In 1990, DES developed a CSO strategy. In broad terms, the strategy consists of a two-step process. The first step is to determine the volume and strength of CSO discharges and their impact on the water quality of receiving waters. Where it is determined that CSOs violate New Hampshire's surface water quality standards, the community must then develop a comprehensive CSO facility plan to determine the most cost-effective solution to abate CSO pollution.

As discussed in Section 2.4.7, efforts to control CSOs are well underway in each community. In general, all CSO communities are either implementing a plan to eliminate remaining CSOs or have undertaken studies for their eventual abatement.

2.4.4 Industrial Pretreatment Program

In accordance with the CWA, some municipal NPDES permits also include requirements to develop (or update) and implement an Industrial Pretreatment Program (IPP). "Pretreatment" refers to measures industry must take to prevent the discharge into municipal sewers of toxic pollutants from industry that are incompatible or will interfere with the municipal wastewater treatment process, that will pass through the treatment plant and cause problems in the receiving waterbody, cause a problem with sludge disposal or poses a health threat to WWTF workers. Dischargers regulated by the IPP are referred to as "indirect" dischargers because their flow does not discharge directly to the receiving water before being treated at the municipal WWTF.

The requirements to implement a federal IPP are generally limited to municipalities with industry that have wastewater treatment plants designed for 5 million gallons per day (MGD) or more.

However, small communities may also be required to implement a federal IPP if nondomestic wastes have caused upsets, sludge contamination or violations of the municipal wastewater treatment plant's NPDES permit conditions. There are currently 13 municipalities in New Hampshire with EPA approved IPPs. Though the State does not have delegation for either the NPDES program or the federal IPP, DES assists EPA by providing program coordination, Pretreatment Compliance Inspections, and reviews of Annual Reports, Sewer Use Ordinances and Local Limits.

New Hampshire also has an IPP which supplements the federal program. Statutory authority for the State IPP is included in RSA 485-A:5. Regulations (Env-Ws 904) regarding standards for pretreatment of industrial wastes were recently revised and became effective on November 16, 1996.

In general, the State IPP requires municipal wastewater treatment plants with industrial contributors to:

* Develop Local Limits and minimum pretreatment standards which are included in its DES approved Sewer Use Ordinance.

* Implement a system to permit all industrial dischargers, including sampling, monitoring and reporting requirements.

* Apply to DES for approval of a Discharge Permit Request (DPR) of the industrial discharge. This is submitted by the municipality using information provided by the industry. DPR approval is required to allow any new industry or any existing industry which is proposing to increase its flow or change its wastewater characteristics, to discharge to the municipal wastewater treatment plant.

The State IPP applies equally to all municipal wastewater treatment plants with or without federally approved IPPs. To date, several municipalities have implemented or are working on their own local pretreatment programs, including Ashland, Bristol, Hanover, Hampton, Lebanon, Littleton, Newport, Rollinsford and Seabrook.

The economic cost to the communities of the pretreatment programs has generally been transferred to the industrial users by means of fees. In addition to municipal program administration costs, industrial users bear the cost of monitoring and pretreatment.

At this time it does not appear that interference of treatment processes or sludge recycling due to industrial discharges or the "pass-through" of industrial wastewater at municipal WWTFs is a significant concern. Continued oversight of industrial pretreatment programs by the State and federal government is necessary, however, to support local pursuit of program goals and to create incentives for pollution prevention.

2.4.5 Permit Compliance and Enforcement Program

Overview

DES regularly inspects NPDES facilities and reviews discharge monitoring reports submitted by permittees for compliance with their permit limitations. When a violation is discovered, and assuming it does not pose an imminent threat to human health or the environment, DES will first do all it can to bring a violator into compliance through technical assistance, pollution prevention techniques, and/or Letters of Deficiency (LODs). This process would allow the violator to voluntarily attain compliance. In many cases it is very effective.

In more serious cases, or where compliance efforts have not been effective, formal enforcement actions may be necessary. These may include Administrative Orders (AO), Administrative Fines, Consent Agreements or Consent Decrees. In cases where court orders such as Consent Agreements or Consent Decrees are to be issued, a referral is made to the New Hampshire Department of Justice. Depending on the availability of resources, and the specifics of a case, enforcement actions may be turned over to the EPA or performed in conjunction with EPA.

Municipal Compliance

New Hampshire remains very concerned that all WWTFs maintain compliance with the requirements of their NPDES permits. Also of continuing concern is the maintenance of physical plants. To insure that local, state and federal investments are secure and that permit limits are being complied with, DES inspectors regularly conduct compliance evaluation inspections (CEIs). Emphasis is placed on the 42 municipal NPDES permits that are categorized as major which are usually inspected on an annual basis. Inspection of the 41 municipal minor permittees are conducted as time and resources allow. At the time of their plant inspections, inspectors stress compliance with permit requirements, correct filing of Discharge Monitoring Reports (DMRs), laboratory quality assurance programs, and correct laboratory procedures for all required testing.

Industrial Compliance

All of the 90 industrial NPDES dischargers in New Hampshire are regularly tracked. However, inspection of the minor industrial facilities are conducted as time and resources allow whereas inspections of the major industrial facilities are usually performed on an annual basis.

At the WWTF facilities, compliance evaluation inspection (CEIs) and, to a lesser extent, compliance sampling inspections (CSI) are performed. As a result of the inspections, comprehensive inspection reports are issued citing deficiencies or recommending corrective actions that usually address monitoring, reporting or record-keeping requirements. In some cases, more formal letters of deficiency and administrative orders are issued.

2.4.6 Wastewater Treatment Facility Technical Assistance Program

For many years DES has had an active technical assistance program for publicly owned wastewater treatment facilities (WWTFs). Frequent on-site inspections are performed each year to assist WWTFs in maintaining compliance. Particular attention is paid to minor facilities that are not currently subjected to routine compliance inspections. Occasionally, assistance is also requested from

industrial dischargers.

In addition to offering highly technical advice, DES also conducts an extensive training program both in classroom environments as well as on-site over-the-shoulder teaching and assistance. This is partially subsidized by EPA's 104(g)1 grant program.

DES has also initiated a Municipal Wastewater Pollution Prevention Program in which treatment plant operators perform self-evaluations. These evaluations are then routed through municipal officials after which an informational meeting may be held between the town and DES staff to discuss WWTF status and possible deficiencies. The principal premise behind this program is to foster improved communications between personnel dealing with the day-to-day operations of treatment facilities and the officials who are ultimately responsible with the well being of the plant. The self-evaluation can also be a good infrastructure-planning tool for local officials.

Finally, DES administers a comprehensive operator certification program . The purpose of this program is to assure that properly trained and responsible personnel oversee the cost effective operation and maintenance of treatment facilities thereby protecting the over $1 billion government dollars invested on such installations in New Hampshire.

2.4.7 Recent Point Source Control Efforts by Basin

Saco River Basin

The Saco River itself is used recreationally by thousands of residents and summer tourists and historically has been one of the cleanest rivers in the State. In recognition of its statewide importance and to further protect its valuable resources, the Saco River was nominated and designated by the State Legislature into the New Hampshire Rivers Management and Protection Program, in 1991.

During the 1980's there was a significant amount of growth and commercial expansion in the North Conway area, all of which was served by septic systems. A study by the USGS confirmed that groundwater in the area exhibited elevated levels of nitrates, the source of which was most likely septic systems. To prevent further deterioration of the groundwater and to prevent pollution of the Saco River itself, it became evident that a collection system and wastewater treatment facility was needed. In 1991, an NPDES permit was issued for a proposed treatment facility in North Conway which would discharge to the Saco River. To maintain the high quality of the river, the permit includes advanced treatment limits, including phosphorus and nitrogen removal. In addition, the permit did not allow the facility to discharge directly to the river in the summer. This was done to further protect primary contact recreational uses of the river, which occur most often during the summer months. In 1992, the Legislature appropriated $1 million to further study the issues. It was decided to construct rapid infiltration basins to discharge highly treated effluent to the groundwater, year-round. The treatment plant went on line in December 1997 and employs biological nutrient removal processes. Essentially, all of the service connections to the collection system have been completed. This facility also serves as a regional septage receiving facility and handles leachate from the local landfill.

Androscoggin River Basin

In the Androscoggin River Basin, point sources affect the mainstem from the City of Berlin to Shelburne. In Berlin, a $1.5 million effort to eliminate over 300 dry weather discharges of untreated wastewater to the Androscoggin and Dead Rivers is essentially complete. Cross connections between the sewer and storm drain pipes were the apparent cause of the untreated discharges.

Though Berlin has completed a project to separate their combined sewers, they technically have one combined sewer overflow (CSO) left which occasionally discharges a mixture of stormwater and untreated wastewater to the Androscoggin River during storm events. Though technically a CSO, it is really an emergency relief to prevent flooding of the main pumping station which pumps wastewater across the Androscoggin River to the wastewater treatment facility. The City continues to monitor the frequency, volume, and duration of overflows and intends to eliminate this CSO by reducing infiltration/inflow (I/I) in the sewers upstream of the pump station. To date, an I/I study has been completed which included televising the sewers, smoke and dye testing in order to identify major sources of I/I. Based on the recommendations of this study, implementation of projects to reduce I/I has begun. Over the past few years, the city has spent close to $1 million to remove I/I. The city will continue to make cost-effective improvements; however, they may soon have to address the more difficult issue of how to reduce I/I from private roof, foundation and sump pump drains.

Connecticut River Basin

The water quality of the Connecticut River Basin continues to benefit from point source pollution abatement efforts. Work conducted over the recent years includes the following:

The 30-year-old wastewater treatment plant in the Town of Colebrook is in need of an upgrade. The Town has performed an engineering evaluation, has selected a design engineer and has procured funding sources for the project. In addition to a facility upgrade, the WWTF outfall will be extended directly to the Connecticut River to maximize available dilution. Design is expected to be completed in early 2000 and construction should commence by 2001.

The Lisbon WWTF has had mechanical problems with a relatively new aeration system. Repairs have recently been made, however, which are expected to resolve these problems.

The Town of North Stratford has recently evaluated the viability of extending their WWTF outfall directly to the Connecticut River which would offer more dilution than the small tributary that they now discharge to. The Town is currently under contract with an engineering consultant to design the new outfall and investigate methods for better effluent pH control.

The staff at the Woodsville WWTF intends to install a static pile sludge composting system on-site as a solution to their solids handling and disposal dilemma. This will generate relatively high quality (Class A) material that can be given away as a soil amendment.

The wastewater facility serving the Sullivan County Complex in Unity currently discharges to a

small receiving stream. Instead of designing and installing an expensive and overly complex system to meet in-stream standards, the County government decided to construct a large interceptor sewer which will tie into the City of Claremont's collection and treatment system.

The Town of Sunapee has retained a consultant to evaluate solids handling options for their WWTF. In facilities such as the Sunapee WWTF, it is essential to be able to process solids effectively in order to maintain effluent quality.

In order to gain energy efficiency and increase flexibility and treatment capacity, the City of Claremont has installed a fine bubble aeration system along with variable frequency drives on their aeration blowers. However, in spite of this, the highly variable industrial loadings that this facility experiences appear to cause filamentous bacteria growth which can impact effluent quality. DES continues to work closely with City staff to solve this problem.

An aeration system replacement / upgrade by the Town of Whitefield in the fall of 1996 has improved this plant's effluent quality. As a result, water quality has improved.

In accordance with its NPDES permit, the City of Keene has hired a consultant to study the feasibility of removing phosphorus from its WWTF effluent. In addition the City is researching ways to meet relatively low effluent limits for copper. They recently completed a copper reducing pilot study using polyaluminum chloride as a coagulant aid. The results were mixed. This facility continues to do a good job of ammonia removal; something the plant was not designed to do. The City also recently installed a fine bubble aeration system which will be more energy efficient and will provide more process flexibility.

In the City of Lebanon, there are several CSOs that occasionally discharge during wet weather to Great Brook and the Mascoma and Connecticut Rivers. Based on a study done in the 1980s, the City has been gradually separating their combined systems. In the spring of 1996, EPA issued an Administrative Order (AO) to the City to complete a CSO Facility Plan, the purpose of which is to identify the least cost alternative to abate CSOs to meet current water quality standards. The City has submitted their CSO Facility Plan and it is expected that by 2001 EPA will an AO requiring the City to eliminate the CSOs by separating their combined system.

The Town of Swanzey WWTF has experienced some effluent excursions in recent years. As a result, DES has worked with the Town to evaluate removing over 20 years of accumulated sludge and to retrofit new aeration equipment. Both projects are expected to be completed in 2000.

Over 30 years of sludge accumulation has also affected the effluent quality at the Groveton WWTF. DES has worked very closely with Town officials to determine the most cost-effective cleaning solution for them. The Town has raised the funding to clean the lagoons during 2000. Additionally, DES has written and received a grant from the State Energy Office to experiment with innovative wind-driven aerators in their lagoons. Data collection will occur during 2000 and installation of the devices is scheduled for 2001.

Merrimack River Basin

Of all the river basins in New Hampshire, the Merrimack has probably shown the most remarkable improvements since it was pronounced one of the "Ten Dirtiest Rivers in America" in the late 1960s.

The Town of Lincoln consistently meets its effluent requirements except for occasional excursions in its recently imposed copper limits. This office has been working with the Town and a local electrical component manufacturer to establish new local pretreatment limits for that industry. These new industrial limits should allow the WWTF to meet the required copper concentrations.

The Waterville Valley WWTF is a national award winning advanced treatment facility. In an effort to reduce the pollutant loading to the expensive and sophisticated advanced portion of their plant, they undertook an extensive lagoon upgrade program by removing accumulated sludge and installing a new more reliable aeration system. They continue to produce an exceptional effluent.

The state-owned and operated Winnipesaukee River Basin Project wastewater facility in Franklin, NH continues to service 10 Lakes Region communities, many of which used to discharge raw or inadequately treated wastewater into local lakes and rivers. They recently installed a state-of-the-art ultraviolet (UV) disinfection system; however, in the past couple of years, they have experienced higher than anticipated storm flows greater than the capacity of the UV system and they have been forced to install a back-up tablet chlorination system to handle peak flows that can't be accommodated by the ultraviolet system. It has been put to the test on a number of occasions and appears to work well. They have also been investigating sources of high flows. This facility has substantially completed the installation of a sophisticated "Supervisory Control and Data Acquisition" (SCADA") system which will allow operators to keep tabs on the wastewater process as well as remote pump stations and sewers located in very environmentally sensitive areas. This will enable them to be notified quickly of any problems arising throughout their entire collection and treatment system.

In the Town of Ashland, a recently installed modern lagoon aeration system is functioning well. Combined with the recent development and implementation of an industrial pretreatment program, the treatability of the influent has improved dramatically and effluent color, long a significant concern in the Squam River, has decreased substantially.

In an attempt to have better process control and to simultaneously cut back on energy consumption, the City of Concord is installing a fine bubble aeration system. They are also investigating the viability of installing new sludge handling and stabilization equipment which will expand disposal and beneficial use options.

The Town of Warner remains under an Administrative Order to improve effluent quality. They have installed a new and improved chlorination/dechlorination system which is still under start-up conditions. They are working on evaluating options for long term solids handling solutions and will hopefully be adding a backup clarifier in the near future for increased process flexibility and reliability.

On the Souhegan River, the communities of Milford and Greenville are under Administrative Orders. Milford has received a very stringent effluent copper limit of 10 parts per billion. They have been performing full-scale pilot studies in the use of poly aluminum chloride (PAC) to assist in the reduction of copper. In addition, by optimizing corrosion control efforts in the drinking water supply, they have had noticeable success in removing substantial amounts of copper through their treatment process. Experimentation at this facility has been performed in cooperation with a professor from Penn State University under a grant from EPA New England. Further upstream, the Town of Greenville has been experiencing effluent violations. The Town has been issued orders and may face fines. DES has urged them to perform a thorough facility evaluation and to make improvements where appropriate. Recently, the Town installed a fine bubble aeration system to increase operational flexibility. Additionally, there has been a change in staffing.

In the Town of Pittsfield, the concentration of suspended solids in the effluent are of concern. The Town has recently hired a consultant to evaluate lagoon sludge removal options and overall plant performance.

The New Boston Air Force Base has a relatively small wastewater facility which discharges into a small receiving water. Because they may be facing very stringent permit limitations in the near future, they are currently evaluating the possibility of establishing a groundwater discharge.

A wasteload allocation (WLA) study of the Contoocook River in 1992 indicated that advanced treatment was necessary at the Jaffrey WWTF to prevent violations of the dissolved oxygen standard at low river flows. In 1994, the NPDES permit for Jaffrey was reissued with advanced limits and in 1995 the Town was issued an Administrative Order requiring the design and construction of an advanced wastewater treatment facility. The Town is currently investigating various treatment alternatives to determine the most cost effective solution, one of which may be to discharge into the ground, via rapid infiltration basins, thereby eliminating the point discharge. This was a conclusion reached by a value engineering study that was recently undertaken. They are also performing pilot studies with various innovative technologies.

In 1995, desktop modeling revealed that advanced treatment may also be needed at the Peterborough and Monadnock Paper Company WWTFs and possibly the Antrim WWTF located downstream of the Jaffrey WWTF on the Contoocook River. In 1997, DES drafted a Total Maximum Daily Load (TMDL) study of the Contoocook River from Peterborough downstream to Hillsboro. Modeling indicated that when the facilities are at design capacity more stringent effluent limits for ammonia and possibly carbonaceous biochemical oxygen demand (CBOD) will be needed. The TMDL study is scheduled to be completed in 2000.

In the cities of Manchester and Nashua, CSOs remain a significant concern. Manchester has a total of 26 CSOs with 18 located on the Merrimack River and eight located on the Piscataquog River. Nashua now has nine CSOs remaining as one CSO was eliminated through separation in 1993. Five of the CSOs discharge to the Nashua River and four discharge to the Merrimack River. Studies have been conducted by both communities to quantify the impacts of the CSOs on the receiving waters. It appears that bacteria and floatables are the major pollutants which must be abated. Both communities

have submitted CSO Facility Plans and are under enforceable orders to implement the agreed upon CSO abatement plan.

Manchester is currently implementing Phase I of their CSO abatement plan, which is expected to cost approximately $58 Million (1998 dollars). This includes separation of 13 of the 26 CSOs, which will eliminate all CSOs along Piscataquog River as well as some that discharge directly to the Merrimack River. As part of Phase I, and in exchange for deferring a decision on how to abate pollution from the remaining CSOs, the City also agreed to spend $5.6 Million on supplemental environmental and public health projects. These include approximately $1 Million for an urban pond restoration initiative, $2 Million to preserve valuable wildlife habitat and wetland areas, $2 Million to address stormwater management and erosion control problems, and approximately $500,000 to tackle childhood lead and asthma poisoning. The City has approximately 5 years to complete the supplemental projects and approximately 10 years to complete the separation work. As part of Phase I, the City will also develop and submit a plan that will address the remaining CSOs.

Nashua is going to eliminate their CSOs by separating their combined system. According to the Administrative Order, the City has until 2019 to complete this work which is estimated to cost in the range of $100 million.

In addition to CSO Abatement programs, the Cities of Nashua and Manchester have also been undertaking significant capital projects. In Nashua, the first, egg-shaped anaerobic digester in New Hampshire, is currently under construction. It is felt that this will not only significantly reduce the volume of residuals that must be handled, but also result in a product that may be beneficially used. The anaerobic digester will also give plant staff better control over potential odor sources.

Odors are also being addressed in Manchester who is close to completing a substantial million-dollar project that entailed covering tanks and treating off- gasses from them. These improvements should significantly reduce incidences of odor complaints from neighbors**.**

Piscataqua and Coastal Basins

Work continues in the Piscataqua and Coastal basins to abate point source pollution. On the Lamprey River, a TMDL study was completed in 1995 which concluded that advanced treatment is needed at the Epping WWTF to avoid dissolved oxygen and ammonia violations in the river. In 1999, Epping's NPDES permit was reissued with advanced limits. As a result, the Town is currently designing an advanced wastewater treatment facility using innovative technology.

On the Cocheco River, the City of Rochester is currently constructing an advanced wastewater treatment plant in accordance with an Administrative Order issued by EPA in 1995 and the City's NPDES permit which was reissued in 1997 with advanced limits. Though the Rochester WWTF provides good treatment, it discharges to a portion of the Cocheco River which is subject to relatively low flows. A WLA and recently completed TMDL for this facility indicates that advanced limits are necessary to prevent violations of dissolved oxygen water quality standards during low river flows. It is expected that Rochester's advanced wastewater treatment facility will be operational by the Fall of

2000.

Upstream of Rochester, the Farmington WWTF has constructed a new secondary clarifier, as well as an improved automated chlorination and dechlorination system. They have retained a consultant to evaluate sludge management and disposal options as their landfill will be closing soon. This will add flexibility to the treatment process and improve effluent quality prior to discharge to the Cocheco River.

The Portsmouth WWTF discharges to the swift flowing Piscataqua River and operates under a 301(h) waiver. In the Spring of 1992, this plant was significantly upgraded to provide advanced primary treatment and dechlorination In recent years, they have experienced operational difficulties with their advanced primary treatment plant which threatened their status as a waiver recipient. Over the last year, DES has worked with the City to affect improvements such as chemically enhanced settling and more rigorous enforcement of sewer user ordinances which has resulted in significantly improved treatment levels.

Although Portsmouth has eliminated seven CSOs, it still has two remaining that discharge to a tidal pond which outlets to the Piscataqua River. Over the next few years the City intends to reduce the volume and frequency of the CSOs by separating portions of the combined sewer system. In the next two to three years, they also intend to update their CSO Facility Plan to determine the most cost effective way to address the remaining CSO discharges.

In 1992, it was believed that Exeter had eliminated all their CSOs through a separation program that began in the 1980s. Though the vast majority of combined sewage overflow was eliminated, the Town discovered in 1993 that some overflow to Clemson Pond, which outlets to the Squamscott River, still occasionally occurs. This was due, not only to a portion of the collection system that was still combined, but also the capacity of the WWTF pumping station which was not great enough to handle the peak stormwater flows. To reduce the volume of CSO, the Town made alterations to the main pump station to increase it’s capacity and are considering installation of a SCADA system which will allow Town personnel to better control high flow events. Ultimately, the Town intends to eliminate this CSO by separation which is expected to be completed by 2002. In addition to CSO abatement efforts, the Town is also evaluating the viability of installing a new outfall diffuser to help them meet water quality criteria, particularly for metals and ammonia.

In the early 1990's, DES and the State of Maine began work on a Total Maximum Daily Load (TMDL) Study for the Salmon Falls River because of dissolved oxygen violations. In 1999, the TMDL was completed and approved by EPA. As a result, NPDES permits for the Somersworth, Rollinsford and Milton WWTFs in New Hampshire, and the Berwick and South Berwick WWTFs in Maine, are in the process of being reissued with more stringent effluent limits. All three New Hampshire WWTFs will have phosphorus effluent limits, with Somersworth and Rollinsford having more stringent conventional limits as well. The permit for Somersworth will also include ammonia limits. Plant modifications to meet these new limits are expected to be completed in the next two to three years.

The Pease Development Authority (PDA) WWTF is currently operated by the City of

Portsmouth. Recently, they reconstructed the outfall diffuser in the Piscataqua River to obtain more dilution which essentially eliminates the need to treat for ammonia and metals. The outfall is shared by the Town of Newington's WWTF which will be similarly effected. Newington has also recently made significant improvements to their disinfection system by installing additional contact tankage and a dechlorination system.

At the Hampton WWTF, which is in the Coastal basin and discharges indirectly to Hampton Harbor, construction of additional aeration tankage and improved diffused aeration equipment has been completed to facilitate nitrification. These improvements have helped to significantly reduce effluent ammonia levels. The Town has also been studying their disinfection system to determine potential improvements and has imposed a sewer connection moratorium while they evaluate the entire facility from a capacity standpoint.

The water quality of Hampton Harbor has benefited from the completion of the new Town of Seabrook WWTF which became operational in 1995. To date, virtually all of the house connections have been made. As a result, many septic systems have been eliminated which have been a suspected source of bacterial pollution in Hampton Harbor. The plant is currently evaluating means to improve the effectiveness and reliability of their disinfection system.

Finally, the conference center on Star Island in the Isles of Shoals, completed a seasonal secondary treatment plant, which includes chlorination and dechlorination capabilities. This eliminated the discharge of untreated wastewater to the ocean. This facility has experienced some operational difficulties during their first few years of operation. DES continues to offer assistance in attempts to improve their process and to maintain compliance.

2.5 NONPOINT SOURCE (NPS) CONTROL PROGRAM

2.5.1 Introduction

This section describes the activities and direction of the DES Nonpoint Source Program. Several new program initiatives have been implemented since during the past two years. In October 1999, EPA approved the updated *Nonpoint Source Management Plan* (NHDES, 1999), which describes program priorities, goals, objectives, and action plans for the next five years. State legislation was passed in 1999 transferring authority for shellfish growing area classification from the Department of Health and Human Services to DES. In September 1999, DES received its first allocation of incremental Section 319 funds to implement NPS restoration projects in priority watersheds, providing over $500,000 for on-the-ground restoration where water quality goals are not being met.

2.5.2 NPS Activities Funded Under Section 319

Nonpoint Source Investigations

Field reconnaissance activities continued in the Coastal watershed during the 1998 and 1999 field seasons. The objective of the program is to find and eliminate sources of bacteria to estuarine

waters which may affect public health via consumption of contaminated shellfish. The field methodology is based on reconnaissance of existing urban stormwater drainage systems for the presence of dry weather flow. Where present, effluent is sampled, and if contaminated, the drainage system is investigated for potential pollution sources, such as illicit sanitary sewer connections. Table II-2-2 describes the coastal basin field investigation schedule; Table II-2-3 summarizes the investigations during 1998 and 1999.

Table II-2-2
Coastal Basin Field Investigation Schedule

Sub-Watershed	Initial Field Investigations Completed (Year)	Ongoing Field Investigations
Squamscott River	1996	
Lamprey River	1996	
Little Harbor/Witch Creek	1996	2000
Hampton/Seabrook	1996	
Winnicut River	1996	2000
Bellamy River	1997	2000
Oyster River	1997	2000
Cocheco River	1997	2000
Newington/Portsmouth	1998	2000
Salmon Falls River	1998	2000
Rye Harbor	1999	2000

Table II-2-3
Summary of Coastal Basin Field Investigations (1996-2000)

Watershed	Problems Requiring Investigation	Actions Taken	Follow-up	Ongoing	Resolved
Squamscott River	Exeter CSO separation	Town Construction		x	
	Jady Hill Outfall	Sampling	x		
	Wheelwright Creek	Sampling	x		
	Great Brook-implement BMPs at farms and golf course.	Further wet weather sampling required.		x	
	Norris Brook-investigate sewage discharge	Norris brook Illicit connections found and discontinued			x

Watershed	Problems Requiring Investigation	Actions Taken	Follow-up	Ongoing	Resolved
Lamprey River	Cross connections at town dock and in Moonlight Brook	(Administrative Order issued to Town of Newmarket) Four cross connections found and fixed	x		
Little Harbor/ Sagamore Ck	Discharge in Sagamore Ck.	City of Portsmouth notified of discharges.		x	
	Four new discharges found, along with seeps and stormwater issues	Bogs Restaurant New Septic installed			x
Hampton Harbor		Removal of animals from Cross Beach Rd.		x	
	Three Stormwater BMPs to be installed.				
	Follow-up samples required Cains Mill Bk		x		
Winnicut River	Possible septic failure	Follow up samples taken	x		
Bellamy River	Pigeon impacts at Sawyers Mills, Resample	Laundry discharge, Rte 108, Follow-up samples indicated one time event.	x		
	Garrison School, Mill Street, Back River Road, Store 24, and Dover Point Road,	Dry weather high bacteria counts at Fisher/Locust St and in Varney Brook Erosion problems at Varney Brook, BMP installed	x		
Cocheco River	Cross connections on Court Street, Central Ave, and Summer Street (Cricket Brook)	3 Illicit cross connections fixed	x		
	High bacteria (dry weather) at Washington Street and Cocheco Street	Sewer main leak on Young Street		x	
	High bacteria (dry weather) in downtown Rochester.			x	
Rye Harbor	Initial Bacterial hits in multiple areas Tribs into Harbor need extensive investigation	Initial Shoreline Surveys completed.		x	
	3 Suspect restaurant septic system failures, Investigation to follow.			x	
	Extensive investigations required			x	

Watershed	Problems Requiring Investigation	Actions Taken	Follow-up	Ongoing	Resolved
Salmon Falls River	Follow-up investigations on bacterial hits.	Shoreline investigations complete, samples taken		x	
Newington Portsmouth	Many Bacterial hits, Multiple straight pipes found, All ongoing investigations.	Fixed 2 illicit connections and One cross connection (Marriot)		x	
Oyster River	High bacteria (dry weather) in Oyster River, College Brook and (wet weather) Pettee Brook, Follow-up investigation	Broken sewer line crossing at Beards Creek Town has replaced sewer line		x	
	Suspected grey water discharge on Pette Brook, multiple samples taken, investigation needed			x	

Local Initiatives Grants

DES continued to make available local initiatives grants for watershed management projects in 1998 and 1999. Table II-2-4 summarizes the projects funded during the past two years.

Table II-2-4
Local Initiatives Grants for Watershed Management
1998 and 1999

Grant Recipient	Project Name	Amount	Year
City of Dover	Dover Water Quality Protection and Enhancement Project	$30,000.00	1998
Connecticut River Joint Commission	Publication of "The Challenge of Erosion in the Connecticut River Watershed."	$4,980.00	1998
Lake Sunapee Protective Association	Sunapee watershed NPS reduction program	$64,465.00	1998
Manchester Water Works	Lake Massabesic Watershed Management Plan	$5,000.00	1998
Merrimack Village District	Merrimack's increased public education	$31,680.00	1998
NH DRED	Franconia Notch/ Lafayette campground erosion mitigation and Mount Sunapee erosion control	$9,000.00	1998
NH Foundation for Sustainable Communities	The Soucook River Watershed Reclamation Plan	$40,000.00	1998

Grant Recipient	Project Name	Amount	Year
NH Lakes Association	Watershed Steward Program	$16,886.00	1998
North Country Council	Natural resource mapping and land suitability analysis - Dumner, NH	$3,375.00	1998
Pleasant lake Association	Pleasant Lake Watershed Survey	$9,000.00	1998
Souhegan Watershed Association	Souhegan Watershed Association Development Program	$13,394.00	1998
Strafford Regional Planning Commission	Cocheco River Watershed Committee	$11,250.00	1998
Upper Merrimack River Local	Upper Merrimack watershed monitoring and	$6,970.00	1998
1998 Total		$246,000.00	
Amherst Conservation Commission	Inventory of Amherst's Watersheds and Wetlands	$7,300.00	1999
Belknap County Conservation District	Winnipesaukee River Clean-Up	$600.00	1999
City of Laconia	Weirs Beach Stormwater Evaluation and Design	$21,000.00	1999
Grafton County Conservation District	Water Quality Laboratory	$13,770.00	1999
Grafton County Conservation District	Baker River Watershed Erosion Control Project	$14,915.00	1999
Hillsborough County Conservation District	Greenscaping II	$1,500.00	1999
Lake Sunapee Protective Association	Beck Brook Runoff Response Program	$10,500.00	1999
Nashua Regional Planning Commission	Robinson Pond Nonpoint Implementation Project	$13,475.00	1999
New England Biosolids and Residuals Association	Continued monitoring at Gravel Pit Reclamation Sites in NH	$15,000.00	1999
NH Lakes Association	Watershed Steward Program Phase II	$19,950.00	1999
Pennichuck Water Works	Technical transfer to Watershed Communities (Workshops)	$11,850.00	1999
	Technical transfer to Watershed Communities (Hot Spots)	$14,940.00	1999
Piscataquag Watershed Association	Shoreline Survey Phase II	$8,015.00	1999
Strafford Regional Planning Commission	Water Quality monitoring in the Cocheco River	$9,420.00	1999
Town of Goffstown	East Union Street Drain	$48,364.00	1999
1999 Total		$210,599.00	

Unlined Landfill Closure

Since 1992, 319 funding assistance has been used for a hydrogeologist in the unlined landfill

program. The major activities of the hydrogeologist consist of technical review of consultants' reports relating to the investigation and closure of the 203 unlined landfills within the State. The closure process includes five major steps:

1) Phase I Hydrogeological Investigation - Site history review and preliminary assessment of fill limits, groundwater flow direction, site geology, and recommended monitoring well locations.

2) Phase II Hydrogeological Investigation - monitoring well installation, evaluate groundwater/refuse contact, two rounds of water quality data, groundwater flow net, recommend closure method

3) Groundwater Permit Issued - establishes a groundwater management zone (GMZ), restricts the use of groundwater within the GMZ, and establishes a formal post-closure water quality monitoring program.

4) Final Closure Plan - detailed engineering plans, specifications, and contract documents are prepared.

5) Facility Closure - the capping and monitoring systems are installed.

Progress during the two year reporting period (1998-1999) is reflected in Table II-2-5 below.

Table II-2-5
Status of Unlined Landfill Closures

Step	# of Landfills Reported in 1998 305(b)	# of Landfills Current Status
Phase I Hydrogeological Investigation	166	168
Phase II Hydrogeological Investigation	150	159
Groundwater Permit Issued	111	118
Facility Closure	66	97

Nonpoint Source Management Plan

The *New Hampshire Nonpoint Source Management Plan* (NHDES, 1999) was completed in October 1999. *The Plan* is an update of the original Plan completed in 1989. It describes the status of nonpoint source problems in New Hampshire and lists specific actions for the next five years relative to statewide programs and Nonpoint source types to improve water quality by preventing and controlling Nonpoint source pollution. The five year action plan will be coordinated by the DES Nonpoint Source Program and will require the cooperation of many other programs and agencies. The

cornerstone of the DES Nonpoint source effort is the watershed program. The watershed program organizes planning, assessment, and implementation tasks for both point and nonpoint source control programs by river basin.

The watershed program relies on both state actions and local leadership. Local leadership can take many forms: a watershed association, regional planning commission, conservation district, municipality, business group, water supplier. The organization should be recognized locally and respected among the various watershed interests so as to be able to work with and through them to effect solutions to problems or derail problems before they occur. Deciding local watershed priorities is the responsibility of the lead organization. DES can assist the local watershed organization with defining its goals and setting priorities to address water quality problems. Some watershed organizations will choose to develop a watershed management plan to direct their actions, while others will adopt a more informal, targeted approach to problem solving.

Restoration Grants

As a result of the President's *Clean Water Action Plan*, released in February 1998, Congress appropriated incremental Section 319 funds to be used by the states on restoring water resources impacted by nonpoint sources. In September 1998, DES published a *Unified Watershed Assessment* which identifies high priority restoration watersheds, where the incremental Section 319 funds could be spent. DES allocated FY99 funds to the projects listed in Table II-2-6.

Table II-2-6
FY99 Restoration Projects

Watershed	Project	Funds Allocated
Coastal	Little Harbor/Back Channel Sanitary Survey	$32,000
	Hampton Harbor Town Parking Lot Stormwater BMP Installation – Phase I	$75,000
	Town of Seabrook Route 1 Stormwater BMP Installation	$64,000
	Seabrook Stormwater Pollution Prevention	$2,000
	Scruton's Dairy Farm, Farmington - manure storage facility, roof, silage leachate containment, paving access road	$50,000
	Jan-Mar Farm, Rochester – roof for feedlot	$20,000
	Little River Salt Marsh restoration	$20,000
	Lamprey River, Newmarket – sediment and erosion control BMP installation	$8,000
	Gulf Watch – mussel monitoring	$1,840
	BMP Construction Project contingency	$5,000
Merrimack	Gunstock and Poor Farm Brook Restoration and Remediation	$25,345

Watershed	Project	Funds Allocated
	Pleasant Lake, Deerfield – Town Beach Erosion Control	$11,018
	Depot Street, Merrimack – Stormwater BMP installation at public boat ramp	$14,012
	Mast Landing, Wolfeboro – Stormwater BMP installation at public boat ramp	$30,000
	Center Harbor Bay, Lake Winnipesaukee – Stormwater BMP installation	$62,378
Chocorua Lake	Tamworth – Route 16 Stormwater BMP installation	$23,300
Connecticut	Clark Brook, Haverhill – Keith Farm Manure Storage BMP installation	$32,000
	Total Allocated:	$475,893

In future years, restoration funds will continue to be applied to projects which restore historic designated uses and which restore water quality. A combination of staff-directed projects and requests for proposals is used to solicit restoration projects. Restoration funds will be available to address nonpoint sources in *Unified Watershed Assessment* restoration watersheds for which total maximum daily loads (TMDLs) are required.

2.5.3 Other Federal, State, and Local NPS Implementation Activities

Sprawl and Smart Growth

Sprawl means the haphazard and unplanned development of and use of land, with physical, visual or audible consequences, in such a manner that is contrary to the traditional and historic New Hampshire landscape. A rural, forested, pastoral and mountain environment with small towns and villages characterizes the historic and traditional landscape. Sprawl is the inflation, over time, in the amount of land area consumed per unit of human activity, and the degree of dispersal between such land areas. The major effect of sprawl is the erosion of the rural and open landscape that gives New Hampshire its traditional character, integrity, and sense of community. The results of sprawl include, but are not limited to:

- The loss of agricultural, forest, and wild land to haphazard industrial, commercial, and residential development;
- The abandonment of commercial activities in cities and towns for strip malls and shopping centers that congest roads, and unnecessarily eliminate open space;
- Increased air pollution;
- Shrinking of aquifer recharge areas;
- Fragmentation of wildlife habitat;
- Grid-type housing developments, rather than cluster developments that retain much of the land in its natural state;
- Proliferation of unnecessary signs along roads and highways that detract from the landscape view;

- Unnecessary noise from all sources that give the impression of an urban, rather than a rural setting;
- Loss of concentrated and vibrant village and city centers; and
- Aesthetic visual degradation of the landscape.

Governor Shaheen, in her Executive Order 99-2, directed the State Council on Resources and Development (CORD) to inventory member agency actions currently underway which promote the retention of New Hampshire's traditional communities and landscapes. The executive order further calls for the identification of ways in which CORD agency programs, rules, and regulations could be improved with regard to their impact on sprawl. CORD released its report to the Governor in December 1999.

The Department of Environmental Services (DES) formed an internal Sprawl Working Group to assess its programs and their relationship to sprawl. Several DES programs facilitate development in existing urban core areas, which helps to maintain New Hampshire's traditional landscape. The Covenant Not to Sue Program and Brownfields Site Assessment programs streamline the process of redevelopment of formerly contaminated sites, typically in urban areas, by assessing the extent of contamination, developing remedial plans, and limiting future liability for current property owners.

DES also provides infrastructure grants and loans to municipalities for water and sewer mains and treatment facilities. These grants and loans totaled more than $48 million during the past two years, providing substantial investment for infrastructure in existing urban core areas.

In addition to facilitating growth in urban areas, DES has focused attention on preservation of significant habitat and other environmentally sensitive lands through wetlands mitigation and supplemental environmental projects. These programs have permanently protected over 2,000 acres of land during the past two years.

Through the Regional Environmental Planning Program (REPP), DES has funded the nine regional planning agencies to inventory important natural resources in each municipality in the State. DES will consult the inventory in determining desirable locations for preservation through mitigation and supplemental environmental projects. It also provides a good resource for local land trusts and planning boards in prioritizing important conservation lands. In the third year of the REPP, which began in July 1999, planning commission staff were trained in Geographic Information System applications to educate planning boards about the connection between land use and natural resources. Each planning commission conducted pilot projects in one watershed to educate land use decision makers about the relationship between growth and natural resources.

To improve agency actions with respect to smart growth, DES is pursuing:

- the use of State Revolving Fund loans for remediation of Brownfields sites;
- reuse of Superfund sites for redevelopment in urban core areas;
- a formal Supplemental Environmental Project policy that favors projects which have an anti-sprawl effect;

- an assessment of the infrastructure programs to determine whether they can be made more sensitive to sprawl (by providing for extensions to new development which limits sprawl); and
- removal of the five acre exemption from subdivision review for new lots.

DES hired a Water Quality Impact Planner in May 1999 to facilitate agency actions addressing sprawl as well as to support the DES Mercury Advisory Committee.

In 1999, the Legislature passed HB 207, *An act directing the Office of State Planning to conduct a study of the effects of sprawl in the state and making an appropriation therefore.* The $40,000 study will examine the effects of sprawl on the economy, taxes, loss of open land, air quality, water quality, wildlife habitat, tourism, community identity and quality of life. In a report due in Fall 2000, the study will offer recommendations on local, regional, and state growth management and associated legislative initiatives.

2.5.4 Future Direction of the NPS Program

The program will continue to conduct basin investigations to identify and abate NPS pollution and to provide local initiatives grants for NPS projects. Basin investigations are anticipated to remain in the coastal watershed through the 2000 field season. When initial coastal watershed investigations are completed, staff will move to the Merrimack watershed and will focus efforts on identified issues, including assistance to NPDES Stormwater Phase II communities, bank erosion, and water quality problems identified on the 303(d) List.

DES hired a Coastal Watershed Supervisor in March 1999 to facilitate restoration activities and work with local watershed management organizations. The long-term plan is to provide such targeted staff assistance in each watershed in the state, beginning with the Merrimack in 2001.

DES will continue to support land protection activities, smart growth initiatives, and riparian area management in addition to restoration activities to comprehensively address watershed management.

PART II, CHAPTER 3

COST/BENEFIT ASSESSMENT

3.1 OVERVIEW

In accordance with EPA 305(b) guidance (USEPA, 1997), an assessment of costs and benefits associated with water pollution control activities is provided in this chapter. Because information is not readily available regarding the costs of privately funded projects or of the specific economic or social benefits of each project, the discussion below focuses on available information, which are the costs associated with past or ongoing public pollution control projects that have received state and/or federal financial assistance.

With regards to benefits, it can be generally said that all types of water pollution abatement projects benefit water quality to some degree, as they are reducing the loading of pollutants into the surface waters. The difficulty lies in trying to quantify the social and economic benefits of each project. Much of this information is not readily available and would take a considerable amount of time and resources to obtain. For these reasons, the discussion of benefits is limited to that provided in Section 3.3 which shows the waterbody benefitted by each of the water pollution abatement projects that received funding under the State Revolving Fund loan program in 1998 and 1999.

3.2 FEDERAL CONSTRUCTION GRANTS PROGRAM

Since the passage of the Federal Water Pollution Control Act of 1972 (Public Law 92-500), EPA assistance to municipalities for the planning, design and construction of projects under the Construction Grants for Wastewater Treatment Works Program has totaled nearly $442 million in grants**.** Under the State Aid Grant Program, New Hampshire has awarded grants for these projects of over $337 million, with actual payments for these projects totaling nearly $272 million. Although it is difficult to determine the actual contribution by municipalities to these projects, it is estimated that local shares over this period are nearly $59 million. This would suggest a total commitment to wastewater treatment works projects in New Hampshire from all funding sources of $838 million during the era of the Construction Grants Program. The phaseout of the federal construction grants program in 1990 was completed in New Hampshire with the administrative completion of all grant projects in Fiscal Year 1997.

3.3 20% - 30% STATE GRANT PROGRAM

In response to the phasing out federal grant funds, the Governor and Legislature stepped forward by enacting Chapter 277 of the Laws of 1992 to provide a new 20 to 30 percent state grant program for local water pollution control projects. This law directs DES to establish and maintain a priority list of projects eligible to receive grant funds, using the existing priority system developed under the federal construction grants program, and further directs that an annual public hearing be held to

receive comments on the priority list. The New Hampshire Water Pollution Control Program has provided 159 grants to 55 municipalities totaling over $51 million under this program. The current priority list includes 119 projects with total costs of over $90 million in Fiscal Year 2000, and 49 projects with total costs of over $51 million in Fiscal Year 2001.

3.4 STATE REVOLVING FUND (SRF) PROGRAM

Under the State Revolving Fund Program, New Hampshire has received $155,799,045 in Federal Fiscal Years (FFY) 1989 thru 1999 Title VI capitalization grant funds as of the end of FFY 1999. In addition, $3,778,369 in Title II funds have been transferred to the State Revolving Fund. These amounts along with the required twenty percent state matching funds of $31,915,483 have provided a total of $191,492,897 for the State Revolving Fund Program. SRF loans to municipalities totaled $171,558,174 Through the end of FFY 1999. Actual disbursements for construction projects in progress totaled $133,007,157 through the end of FFY 1999.

Table III-3-1
State Revolving Fund Commitments For 1998 & 1999

Municipal Loan Recipient	Improvement Funded	Waterbody Benefited	Loan Amount
Lebanon	Landfill Closure	Groundwater Protection	$2,444,161
Hampton	Landfill Gas Remediation	Groundwater Protection	$147,777
Nashua	Sludge Handling Facility	Merrimack River	$9,700,000
Colebrook	WWTP Improvements	Connecticut River	$600,000
Boscawen	Landfill Closure	Groundwater Protection	$980,000
Whitefield	Sewer System Improvements	Groundwater Protection	$172,000
Hooksett	Sewer Extensions	Groundwater Protection	$344,285
Manchester	WWTP Improvements	Merrimack River	$2,422,000
Manchester	Cohas Brook Interceptor	Groundwater Protection	$7,533,000
Hampton	Winnacunnet Rd. Pump Station	Atlantic Ocean	$1,400,000
Haverhill	Sewer System Extension	Groundwater Protection	$650,000
Portsmouth	Landfill Closure	Groundwater Protection	$1,195,000
Manchester	WWTP CSO & Bypass	Merrimack River	$1,600,000
Walpole	Landfill Closure	Groundwater Protection	$500,000
Newington	Landfill Closure	Groundwater Protection	$122,000
North Hampton	Landfill Closure	Groundwater Protection	$90,000
Sutton	Landfill Closure	Groundwater Protection	$258,000
Sullivan County	Sewer Interceptor System	Chase Brook	$1,835,000
Carroll County	WWTP Improvements	Groundwater Protection	$152,500
			$32,145,723

PART II, CHAPTER 4

SPECIAL STATE CONCERNS

4.1 INTRODUCTION

Although tremendous progress has been made in the past 25 years to clean up surface waters in the New Hampshire, there is much more to be done. The following is a list of the major remaining water quality concerns and issues in the State that DES and others will be directing their attention to in upcoming years.

4.2 UPGRADING EXISTING WASTEWATER TREATMENT FACILITIES

As a result of a twenty year construction program, all of the major municipal wastewater treatment facilities in New Hampshire have been built. In accordance with the technology limits of state and federal law, all municipal discharges receive at least secondary treatment. Subsequent monitoring and modeling efforts, [i.e. wasteload allocation or Total Maximum Daily Load (TMDL) studies], however, have shown that in order to meet in-stream water quality standards for dissolved oxygen, advanced treatment is necessary at the following facilities:

*	Rochester WWTF	Cocheco River
*	Epping WWTF	Lamprey River
*	Jaffrey WWTF	Contoocook River
*	Peterborough WWTF	Contoocook River
*	Monadnock Paper Company WWTF	Contoocook River
*	Somersworth WWTF	Salmon Falls River
*	Rollinsford WWTF	Salmon Falls River

In accordance with a Consent Agreement issued in 1995, the City of Rochester is in the process of constructing an advanced WWTF. It is expected that the WWTF will be operational by 2001.

In 1995, a TMDL was completed on the Lamprey River. The study showed that advanced limits are needed at the Epping WWTF. In February, 2000 the NPDES permit for the Epping WWTF was reissued with advanced treatment limits. Design of a WWTF to meet these limits is underway with construction anticipated to begin in 2001.

On the Contoocook River, the Town of Jaffrey is under Administrative Order to design and construct a facility that will meet the advanced limits. The Town is currently investigating various treatment alternatives to determine the most cost effective solution.

In 1997, DES submitted a draft TMDL to EPA, for the Contoocook River from Peterborough downstream to Hillsboro. Modeling indicated that when facilities are at design capacity, advanced limits will be needed at the Peterborough and Monadnock WWTFs and possibly the Antrim WWTF. It is expected that this TMDL will be completed this year.

In 1999, New Hampshire and Maine finalized a joint TMDL study for the Salmon Falls River which requires advanced limits for several WWTFs in Maine as well as New Hampshire (Somersworth and Rollinsford WWTFs). Permits with advanced treatment limits are expected to be reissued in 2000.

4.3 COMBINED SEWER OVERFLOWS

Combined sewer overflows were addressed in Part II, Chapter 2. As mentioned, there are currently 46 CSOs located in the five New Hampshire communities of Berlin (1 CSO), Lebanon (7 CSOs), Manchester (26 CSOs), Nashua (9 CSOs), Portsmouth (2 CSOs), and Exeter (1 CSO). Each of these communities is either developing or implementing a plan to abate CSO pollution. Studies to date suggest that bacteria and floatables are the major pollutants of concern. It is anticipated that CSO remediation costs will exceed $200 million statewide. To expedite implementation of CSO abatement plans, federal funding assistance will be needed.

4.4 PERMITTING MINOR WASTEWATER TREATMENT FACILITIES

At the present time there are a total of 173 NPDES permittees in New Hampshire. Of these, 66 are categorized by EPA as "major" and the remaining 107 are categorized as "minor". Due to limited resources at EPA, however, only the major permits are regularly reissued every five years. Priority is given to the major facilities because they usually discharge the most flow and therefore have a high potential to impact receiving waters.

Because so much regulatory attention has been given to the major facilities in the past, most are in good condition and are meeting current water quality standards. The same, however, may not be true for the minor facilities which, although they have relatively small flows, represent approximately 62 percent of the total number of NPDES facilities. Some of these facilities may be impacting water quality because they are in poor operating condition or because their permits do not reflect current water standards. To determine this, more attention needs to be directed towards inspecting and tracking the minor facilities and reissuing their permits to ensure that they are protective of water quality.

EPA and the State are working very diligently to reissue all of the major and minor permits by the end of federal fiscal year 2003. Since 1993, however only 20 of the 107 minor NPDES permits have been reissued. To expedite reissuance of the remaining minor permits, additional federal funding is needed.

4.5 NONPOINT SOURCES

The major contributors to nonpoint source (NPS) pollution are people at home, work and play. To address such NPS issues it is necessary to 1) convince people that a problem exists, 2) develop reasonable solutions and 3) fund the solutions. To date numerous solutions (i.e., best management practices or BMPs) have been developed to abate NPS pollution. Education and funding, therefore, are major obstacles which must be overcome to resolve NPS water quality concerns.

A combination of approaches is necessary to improve water quality through nonpoint source pollution prevention and control efforts. Education and outreach are essential since many water quality impairments are the result of the cumulative impacts of individual actions. Integration of land use planning, land protection, and BMP implementation remains a challenge in preventing and controlling NPS pollution. Permanent protection of critical lands, including riparian buffers and headwater streams, is essential to maintaining water quality, particularly in urbanizing areas. Assisting communities with complying with Phase II of the federal NPDES stormwater permitting requirements will also help to abate urban stormwater pollution. If development is located away from critical areas, then best management practices (BMPs) can do their job.

4.6 OPENING SHELLFISH BEDS

As discussed in Part III, Chapter 6, the State is very committed to finding ways to open more shellfish beds in coastal waters that are currently closed due to bacterial contamination. To date, about $100 million has been spent to reopen shellfish beds and abate pollution in the coastal area.

The major remaining point sources of pollution are two CSOs located in Portsmouth and one CSO in Exeter. The CSOs in Portsmouth discharge to a tidal pond (South Mill Pond) which outlets to the Piscataqua River. Over the next two years the City is proposing to separate portions of their combined sewer system which should reduce the frequency of CSO discharges. To determine the most cost effective way to abate pollution from the remaining CSO discharges, the City will update their CSO Facility Plan in the next two to three years. The CSO in Exeter discharges to Clemson Pond which outlets to the Squamscott River. The Town is in the process of eliminating this CSO by separating the few remaining combined areas in the City. This work should be completed by 2002.

With most point sources under control or in the process of being abated (at least within New Hampshire) attention is now being directed towards abatement of nonpoint sources (NPSs) of bacteria. Isolation and identification of NPSs of bacteria, however, is a much more difficult, costly and time consuming project. As discussed in Part III, Chapter 6, designation of New Hampshire's estuaries as part of the EPA National Estuary Program (NEP) in 1995, served to provide the much needed funding and focus to address such nonpoint concerns in a more comprehensive and coordinated manner. In 1999, the NHEP release a draft *Management Plan* for public review and comment which includes numerous goals, objectives and "action plans" to improve and protect the State's estuaries. It is expected that this document will be finalized in 2000. Once finalized, federal funding will be needed to expedite implementation of the Management Plan which will hopefully result in the opening of more shellfish beds in the estuaries.

4.7 BIOMONITORING

Surface water assessments in New Hampshire continue to be primarily based on chemical/physical data. Unlike chemical analyses, bioassessments may have the potential to reveal the integrated effects of different pollutant stressors over long periods of time and thus provide a holistic measure of their aggregate impact (USEPA, 1991). Baseline biomonitoring information is also needed before numeric biomonitoring criteria can be developed.

In 1995 DES received a grant from EPA to initiate what is hoped to be a comprehensive

biomonitoring program for the ultimate purpose of assessing the biological integrity and ecological health of the State's surface waters. Two positions were created to begin program development and implementation. Initial activities have included field and laboratory protocol development, database design for program monitoring efforts, and field activities to begin characterizing the State's resident biological communities and associated riparian and aquatic habitats.

Though the DES biomonitoring program is off to a good start, much more remains to be done. To continue with the biomonitoring program, additional federal funds are required.

4.8 MERCURY IN FISH

As discussed in Part III, Chapter 8, a statewide fish consumption advisory was issued in 1994 for all inland freshwater bodies because of mercury levels found in fish tissue. The advisory recommends limiting the amount of fish eaten per month. Symptoms of mercury poisoning can include loss of sensation in the extremities (paresthesia), loss of coordination in walking, slurred speech, diminution of vision and/or loss of hearing.

Human related sources which may emit mercury into the atmosphere include coal combustion, smelting, and waste incineration. Although New Hampshire sources emit some amounts of mercury, it is suspected that substantial quantities are also emitted in states upwind and carried east by prevailing winds. Mercury is then deposited upon the lakes and soil of New Hampshire.

Efforts are underway at the federal, state and regional levels to address mercury contamination in the environment. In 1997, EPA released the "*Mercury Study Report to Congress*", to help states plan for mercury mitigation (USEPA, 1997b). The study concluded that the largest source of mercury emissions in the Northeast are municipal waste combustors.

In New Hampshire, a state level mercury reduction strategy was drafted and released in October, 1998. The strategy contains 40 recommended actions to reduce mercury releases in New Hampshire, including those from medical and municipal waste incineration and power generation. Implementation of the strategy is expected to result in a 50% reduction in mercury releases by 2003, with a long-term goal of the virtual elimination of man-made mercury releases. Legislation passed in 1999 imposes a stringent mercury emissions limit on the states' largest municipal waste combustor. The strategy also emphasizes source reduction, and recently introduced state legislation on mercury-containing products focuses on dramatically reducing the use of non-essential mercury in common products and properly managing and recycling these products so that they are not incinerated or landfilled. In addition, outreach efforts to hospitals, businesses and citizens on mercury reduction are ongoing.

New Hampshire is also participating in an effort led by the New England Governors Conference and the Eastern Canadian Premiers to implement the Regional Mercury Action Plan, adopted by the Governors and Premiers in June, 1998. Although significant progress has been made since the release of the mercury reduction strategy, much remains to be done.

4.9 INTRODUCTION OF NON-NATIVE NUISANCE AQUATIC SPECIES

Preventing the spread of zebra mussels into State waters and reducing the spread of non-native plant species such as milfoil and fanwort are major concerns of the State. As discussed in Part III, Chapter 5, DES, New Hampshire Fish and Game and the University of New Hampshire (UNH) Sea Grant program are working cooperatively to combat the importation of zebra mussels. The State Clean Lakes program serves to protect and restore lakes from nuisance aquatic plants. In 1997, new legislation was passed to prohibit the sale, transport and introduction of exotic aquatic weeds in the State. Such programs must continue to prevent the introduction and spread of non-native nuisance aquatic species in New Hampshire's surface waters.

4.10 FUTURE FUNDING FOR WATER POLLUTION CONTROL PROGRAMS

Maintaining the high quality of surface waters in New Hampshire requires a variety of programs such as those described in Part II, Chapter 2. It is extremely important that adequate federal funding is provided in the future to support such essential core programs to 1) prevent the degradation of surface waters in the State and 2) to protect the hundreds of millions of dollars which have already been invested to achieve the current high water quality. In addition, federal funding is needed to support the Total Maximum Daily Load (TMDL) program and other federal requirements such as the development and implementation of a more comprehensive surface water monitoring program.

PART III

SURFACE WATER ASSESSMENT

PART III, CHAPTER 1

SURFACE WATER MONITORING PROGRAMS

1.1 DES AMBIENT SAMPLING PROGRAMS

1.1.1 Rivers and Streams

To assess the ambient water quality of streams and rivers in New Hampshire, DES initiated a rotating watershed monitoring program in 1989. At that time, the State was divided into three areas: 1) the Connecticut River basin, 2) the Merrimack River basin and 3) the Androscoggin, Saco, Piscataqua and Coastal River basins. The intent of dividing the State in this manner was to allow each basin to be sampled at least once every three years.

In 1989, the Connecticut River basin was sampled followed by the Merrimack River basin in 1990. The remaining four basins, (i.e. the Androscoggin, Saco, Piscataqua and Coastal river basins) were sampled in 1991. Upon the completion of the first round of basin sampling in 1991, the second round of the rotating basin monitoring program was initiated in 1992 when the Connecticut River basin was once again sampled.

From 1989 to 1992, approximately 300 samples collected from approximately 100 stations were analyzed each year. Included among these stations are the five National Water Quality Surveillance System (NWQSS) and twelve Primary Monitoring Network (PMN) trend stations which are located throughout the State as shown on Figure III-1-1. Since 1989, these seventeen trend monitoring stations have been sampled each year regardless of which basin was being focused upon.

During these years, each station was sampled three times during the summer months of June, July, and August when river flows are low and temperatures are high. It is during these conditions that sources of pollution generally exert their greatest effects. In many cases, sampling stations were located to bracket existing treatment facilities to provide compliance data and to help isolate pollution sources. Parameters which were typically measured during each round of sampling at each station are shown in Table III-1-1.

From 1993 to 1996, the regular rotating basin sampling program was changed in order to focus on waterbodies which have shown potential water quality violations. In addition to the seventeen trend monitoring stations, sampling locations were primarily based on the list of potentially impaired waters included in the 1994 and 1996 305 (b) reports. The goal of the sampling program during this period was to 1) verify if water quality exceedances, based on limited data, were violations of State standards; 2) identify the source of the violation; and 3) eliminate or abate surface water quality violations. In 1997, DES resumed the rotating basin sampling program with the focus being the Connecticut River basin. Approximately 100 stations were sampled in 1997. In 1998, DES sampling efforts concentrated on the Androscoggin, Saco

Figure III-1-1
National Water Quality Surveillance System (NWQSS) and
Primary Monitoring Network (PMN) Station Locations

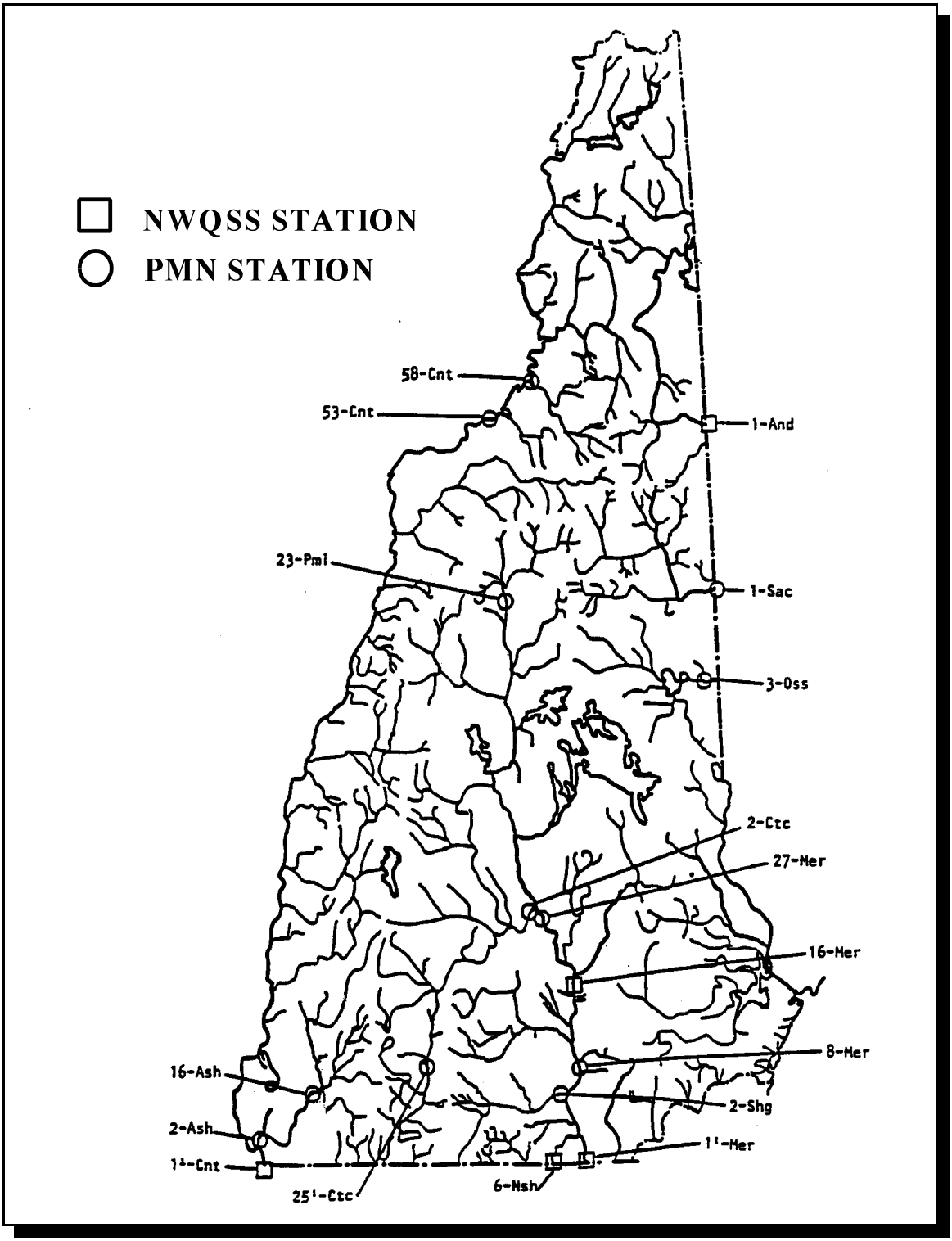


Table III-1-1
Parameters Typically Measured in Rivers and Streams

Sample Round	Parameters
Number 1 (20 parameters)*	E.coli, dissolved oxygen, temperature, conductivity, pH, chlorophyll a, BOD_5, alkalinity, hardness, metals (aluminum, copper, lead, zinc), turbidity, total solids, total suspended solids, nitrate, ammonia, total kjeldahl nitrogen (TKN), total phosphorus
Numbers 2 & 3 (12 parameters)	E.coli, dissolved oxygen, temperature, conductivity, pH, BOD_5, turbidity, total solids, total suspended solids, ammonia, total kjeldahl nitrogen (TKN), total phosphorus

* These 20 parameters were measured during each of the three sampling rounds at the five NWQSS and twelve PMN trend monitoring stations.

and Piscataqua basins and, in 1999, the Merrimack River Basin was the primary focus of sampling.

Field information collected for each site included dissolved oxygen, water temperature, specific conductance, turbidity and pH. Laboratory analyses conducted on each sample depended on which water quality criteria had been historically exceeded at the site. In most cases this meant that samples were analyzed in the laboratory for bacteria (E. coli), and/or certain metals.

In recent years, intensive water quality surveys have also been conducted by DES on the Contoocook and Ashuelot rivers as part of separate studies to determine the "total maximum daily load (TMDL)) of these rivers. By federal law, TMDLs are required on water quality limited segments where technology limits are not adequate to meet water quality standards. Unlike the traditional wasteload allocation (WLA) studies which focus on developing allowable loads for point sources, the purpose of TMDLs is to develop allowable loadings for point sources as well as nonpoint sources.

1.1.2 Lake Monitoring

Information on lake monitoring is provided in Part III, Chapter 5.

1.1.3 Coastal Monitoring

Monitoring of coastal waters to determine the suitability of the beaches for swimming is primarily done by DES. Weekly samples are collected each summer from the major coastal beaches and are analyzed for enterococci, which is the State's bacterial standard in tidal waters used for swimming (see Appendix A).

Monitoring of the State's estuaries is a joint effort involving DES, the Department of Health and Human Services (DHHS), the New Hampshire Fish and Game Department (NHFG), the Office of State Planning (OSP) and the Jackson Estuarine Laboratory (JEL) of the University of New Hampshire. The primary purpose of most of these monitoring efforts is to determine the suitability of estuaries for shellfishing, details of which are provided in Section 1.4.

1.2 VOLUNTEER MONITORING

Water quality information collected by volunteers is a valuable addition to DES monitoring programs. The volunteers are usually in close proximity to the waterbody they monitor and contribute an intimate knowledge of the historical and present condition of the watershed area. Volunteers work with DES to locate water quality threats and potential violations for investigation. Volunteer monitoring can result in early detection of water quality changes, allowing DES to trace potential problems to their source before a severe impact is made. Volunteer monitoring also can provide information about water quality at locations and at a frequency that DES sampling programs are not always capable of accomplishing. With training and appropriate quality assurance and control (QA/QC), volunteer data can supplement the ambient sampling program, as well as the biomonitoring program, and help build a strong set of baseline data statewide.

As discussed in Part III, Chapter 5, the DES Volunteer Lake Assessment Program (VLAP) and the University of New Hampshire Lay Lakes Monitoring Program (LLMP) are active, successful and complementary volunteer monitoring program for lakes. Plans are currently underway to develop a joint website to share water quality data from DES and UNH, along with others that want to submit data.

The huge success and popularity of VLAP serves as a model for the Volunteer River Assessment Program or VRAP ("vee-rap"), which DES initiated in 1998. VRAP is an education and technical assistance program designed to support and coordinate volunteer monitoring of New Hampshire rivers. The main goals of VRAP are as follow:

* To educate the public about rivers and water quality;
* To organize groups to monitor water quality according to their goals;
* To provide monitoring guidelines, equipment loans, and technical training;
* To standardize data collection and management; and
* To report results and recommendations to volunteers.

VRAP aims to offer volunteer groups assistance with general organization, cooperative goal formation, study design, sampling site selection, technical training and equipment loans for river monitoring. The program's educational outreach activities are intended to foster a greater sense of responsibility towards water resources among schools, businesses, local governments and individuals. Several existing watershed associations, local river management advisory committees and other established river groups in New Hampshire have implemented volunteer river monitoring programs, as discussed below:

COCHECO RIVER: The Strafford Regional Planning Commission was awarded a DES Local Initiative Program grant to support a coordinator for the Cocheco River Watershed Coalition (CRWC) volunteer monitoring project and sampling in addition to the VRAP baseline parameters (dissolved oxygen, temperature, pH, conductivity and turbidity). The City of Rochester Public Works Department donated in-kind services including analysis for E. coli bacteria and offered an extremely valuable municipal partnership. The Volunteer River

Assessment Program provided field training and equipment.

Three monitoring teams, complete with field leaders, became known as the very dedicated 1999 Cocheco River Watch (CRW). Ten sites on the main stem of the Cocheco River were monitored every other week from its upper limits in Farmington to the tidal dam in Dover from May through September 1999. Sampling sites for the 1999 CRW project were selected from among those previously tested by the DES Ambient Sampling Program and areas perceived as problematic by the CRWC. Potential problem areas throughout the watershed were identified by CRWC through a group review of historical and recent water quality sampling with guidance from DES staff. Four tributaries to the Cocheco River were also investigated through shoreline surveys, and twice, during the summer, samples were collected for metals analysis conducted at the DES Laboratory Services Unit in Concord. DES Laboratory Services and the UNH Lakes Lay Monitoring Program analyzed biweekly samples for total phosphorus.

Data generated by this project will be used in educational outreach for thirteen watershed communities; by interest groups and the general public; for long-term watershed management; and for decision-making by community land use boards and departments of planning and public works. Regionally, the data will be provided to coastal watershed agencies and organizations for use in resource planning. The CRWC has been awarded another DES Local Initiative Program grant to continue investigating water quality in areas that showed potential violations of water quality standards.

EXETER RIVER: The Exeter River Local Advisory Committee (ERLAC) began volunteer water quality monitoring program of the Exeter River. The Exeter River Watershed Management Plan recommends the establishment of a volunteer water quality monitoring program, and volunteers joined VRAP when it was first initiated in 1998.

Members of ERLAC, the Exeter Conservation Commission and other volunteers have been investigating the water quality of the Exeter River since 1998. The Town of Exeter has been very enthusiastic and supportive of the project, and volunteers are beginning to monitor locations upstream of Exeter.

LAMPREY RIVER: In 1998 the Lamprey River Watershed Association (LRWA) spearheaded the formation of a volunteer water quality monitoring program on the Lamprey River. Monitoring is accomplished through a partnership among several groups with a strong interest in the health of the river, local wildlife, aquatic recreation, and the educational opportunities the river offers us all. The LRWA and other watershed residents have monitored the river for two years and have been successful in expanding the sampling from Epping in 1998 to include Lee, Durham, and Newmarket in 1999.

The Town of Epping has been very supportive of the project, and the Rockingham Waste Water Treatment Facility provided analysis of samples for the group in 1998. Great Bay Coast Watch also supported the initiation of sampling activities with middle school students in Epping. Epping Middle School acquired a grant from the New Hampshire Estuaries Project (NHEP) to purchase monitoring equipment. The students, and a few dedicated teachers, use the VRAP

data collected during the summer to supplement testing done by the students in the spring and fall.

MID-UPPER CONNECTICUT RIVER: The Grafton County Conservation District, UNH Cooperative Extension in Grafton County, Woodsville High School and DES are organizing the Mid-Upper Connecticut Water Quality Laboratory at Woodsville High School for the following mutual purposes:

* To create a professional water quality laboratory to support environmental protection and educational needs of the north country in New Hampshire.

* To maximize the use of available resources to gather water quality samples, analyze them according to standard methods, and report on the quality of surface waters in the region.

* To increase public awareness about environmental conservation and protection with emphasis on the region's water resources - rivers, streams, lakes and ponds.

* To provide students, volunteers, and the public opportunities to participate in water quality monitoring, analysis, and data interpretation. Also, to aid in the education and appreciation of environmental conservation and protection of water resources.

SOUCOOK RIVER: Members of the Soucook River Watershed Project worked with VRAP to initiate volunteer monitoring of the Soucook River in 1999. The group is interested in establishing high quality baseline water quality information in a watershed that is undergoing a great deal of development.

UPPER MERRIMACK RIVER: In 1995, the Upper Merrimack River Local Advisory Committee (UMRLAC) entered into a unique cooperative agreement with NHDES and the Merrimack River Watershed Council. In its first year, the resulting Upper Merrimack Monitoring Program (UMMP) monitored river quality at seven sites on the Pemigewasset, Winnipesaukee, Contoocook and Merrimack Rivers from Franklin to the confluence of the Contoocook and Merrimack Rivers in Boscawen. In 1996, the program was expanded to include sites on the Merrimack in Concord and Bow south to Garvin's Falls. A total of eleven sites are now monitored for E.coli, field chemistry, habitat assessment, and benthic invertebrate collection and analysis to the family level. Water samples are collected from the eleven sites by volunteers every other week for eight to ten weeks during the summer and fall. E.coli samples are submitted to the Franklin Wastewater Treatment Facility for analysis. The UMMP deploys artificial substrates (rock baskets) at each of the eleven sites for a seven week colonization period by aquatic macroinvertebrates. Rock baskets are retrieved and processed in September with subsequent subsampling and family level identification of invertebrates conducted by volunteers at a series of annual workshops hosted by participating schools within the Upper Merrimack watershed. A portion of the invertebrate samples are sent to an independent laboratory specializing in invertebrate analyses as a measure of quality control. Information collected from UMMP (using its EPA-approved Quality Assurance / Quality

Control Plan) is shared with the Volunteer Environmental Monitoring Network and the NHDES Biomonitoring Program.

OTHER RIVERS: VRAP also assists existing citizen monitoring programs in their efforts. These include groups such as the Lower Merrimack Monitoring Program (Souhegan, Nashua and Lower Merrimack Rivers) and the Harris Center for Education in the Contocook River Watershed.

Along the coast, the Great Bay Coast Watch, with the support of the New Hampshire Fish and Game Department and the Office of State Planning New Hampshire Coastal Program, has an active estuary sampling program in the Piscataqua/Little Bay/Great Bay area. This data is used to supplement the Department's programs.

1.3 TOXIC MONITORING

In general, New Hampshire is not subject to heavy industrial discharges of toxic contaminants. To monitor toxics, DES currently uses a variety of approaches. As previously mentioned, some toxics, such as metals, are monitored annually as part of the Department's ambient monitoring program for rivers and streams. Toxics monitoring for lakes (aluminum and acidity) are discussed in Part III, Chapter 5.

Biomonitoring is another tool that the State uses to monitor toxicity. Details of this program are provided in Section 1.5.

In an effort to ensure that direct dischargers to the State's surface waters do not cause toxicity in the receiving waters, most NPDES permittees are required to perform routine toxicity testing of their effluent. These tests, called whole effluent toxicity (WET) tests, are designed to simulate the toxicity of the effluent on aquatic organisms in the receiving water

In coastal waters, numerous historical and current studies have been conducted to monitor toxics in the water column, sediments and in shellfish tissue. A comprehensive review of this work is provided in a characterization report prepared by the University of New Hampshire, Jackson Estuarine Laboratory (Jones, 1997- draft). Major sources of information include ecological risk assessments for the Portsmouth Naval Shipyard, the Gulfwatch annual reports, Army Corps of Engineers dredge project data, NPDES monitoring data, numerous reports by Normandeau and Associates, reports regarding clean up efforts at the former Pease Air Force Base, and studies conducted by University of New Hampshire. Contaminants with the most available information based on their local distribution, historical and current sources and potential toxicity are chromium, mercury, tin and lead.

Depending on the type of facility, recipients of State groundwater discharge permits may also be required to test for toxics in the groundwater as well as in the surface water if the facility is likely to impact the receiving waterbody. This information combined with the ambient monitoring data, the WET test data, and biomonitoring data are all used to monitor and control toxicity in State waters.

1.4 SHELLFISH MONITORING

Routine monitoring of shellfish waters is primarily a joint effort by DES, the Department of Health and Human Services/ Public Health Laboratory (DHHS), the New Hampshire Fish and Game Department (NHFG), and the Office of State Planning / NH Coastal Program. Assistance is also provided at certain locations by the Jackson Estuarine Laboratory (JEL) of the University of New Hampshire. Actual monitoring of shellfish waters and pollution sources, to determine if shellfish can be safely harvested was previously the responsibility of the DHHS; however, in 1999, the NH Legislature transferred the authority to DES.

Monitoring data is used to satisfy U.S. Food and Drug Administration (USFDA) standards for human consumption of shellfish. Unless sufficient data demonstrating acceptable water quality is available, federal standards require that the shellfish beds be closed.

As shown in Table III-1-2, a total of 73 stations were sampled in 1999 as part of the routine shellfish water monitoring program including three new sites in Great Bay Estuary, three new sites in the Little Harbor/Back Channel area and 17 new sites along the Atlantic Coast (shore and boat stations). In general, most stations are sampled at least ten months of the year as it is sometimes not possible to sample all stations year-round due to freezing conditions.

Numerous other studies have also been conducted in the past to supplement the routine bacteria monitoring headed by DHHS. An excellent literature review of this work, organized by estuary, is provided in a characterization study prepared by the NH Estuaries Project (Jones, 1997-draft). Reviews of studies done by DES, JEL, OSP, the Great Bay Coast Watch and others are included. Data from these studies are often used to help make shellfish bed classification decisions (i.e., approved, conditionally approved, restricted, etc.).

1.5 BIOMONITORING

One of the goals of the Clean Water Act is to maintain the biological integrity of the Nation's surface waters. In-stream biomonitoring assessments are considered to be the most direct possible measurement of this goal. Bioassessments typically examine species richness, species composition, population size and trophic composition of resident aquatic organisms. Such information may help to reveal if aquatic organisms are adversely impacted by the integrated effects of different pollutant stressors over long periods of time.

Examples of where biomonitoring has been conducted by DES prior to 1995, or by other organizations, include portions of the Merrimack River (NHDES, 1993a), the Piscataquog River (NHDES, 1993b), the Lamprey River (NHDES, 1994b), Mink Brook (CRWN, 1995) and on several tributaries feeding Lake Sunapee (LSPA, 1996). The focus of these studies was on the diversity of the benthic macroinvertebrate community. Examples of biomonitoring efforts on lakes and ponds can be found in Part III, Chapter 5.

Table III-1-2
Shellfish Monitoring Stations Sampled Monthly By DHHS

Location	Number of Active Sites (1999)
Hampton Harbor and Tributaries	10
Rye Harbor	4
Little and Back Channel Harbor	14
Atlantic Coast	17
Great Bay Estuary (Great Bay, Little Bay, Upper/Lower) and Piscataqua River	25
Great Bay Estuary Tributaries	3
Total Number of Stations Sampled each Month	**73**

In 1995, DES received a grant from the EPA to initiate a long term biological monitoring program for the State of New Hampshire. The DES biomonitoring program utilizes a stratified probability based monitoring design to select regional reference streams of third order and higher systems. Potential sites are selected based on road density, population statistics, adjacent land uses, and proximity to facilities such as wastewater treatment plants, impoundments, landfills, and state/federal superfund sites. Sites are then randomly selected out of the candidate pool. In addition to this approach, some “stressor” sites are beginning to be selected in order to have a complete range of water quality conditions in New Hampshire for development of numerical biological criteria. The biomonitoring program routinely collects three specific types of data; biological data, habitat data, and physical/chemical data as described below.

Two aquatic communities are assessed for the biological data component, fish and macroinvertebrates. The two communities provide overlap on assessing ecological health and have the ability of revealing particular “stressors” (i.e. flow) that may be exclusive of one particular group. The fish community is included as it is a useful tool for assessing bioaccumulative effects of contaminants, and is something that can be easily related to by the general public when reporting.

Based on the latest EPA 305(b) Guidance (USEPA, 1997a), the biological data collected by the DES biomonitoring program would be considered between a “level 3" and a “level 4" as the two assemblages that are collected are of high data quality. In addition, the fish are identified to species by a trained professional biologist and monitoring follows standardized field protocols for consistency in data collection efforts. Finally, macroinvertebrate samples are collected using standardized field and laboratory protocols and are sent out to a reputable taxonomic laboratory with standardized laboratory QA/QC procedures for species level identification.

Habitat data is considered a “level 3" according to EPA 305(b) guidance as it is a visual based assessment using standardized protocols and assessment sheets for low and high gradient stream types. A third type of habitat form is scheduled to be developed within the DES biomonitoring program in order to address unique stream systems in New Hampshire. Compilation of land use data is presently being pursued and some quantitative measurements of specific parameters are made. The habitat assessment sheets address ten different riparian and surrounding land use characteristics which are used for making aquatic life use support decisions.

As part of the biomonitoring program, water quality parameters such as dissolved oxygen, acid neutralizing capacity, pH, temperature, and specific conductance are also routinely tested. Other measurements and analyses are taken as deemed necessary.

Habitat, macroinvertebrate, fish, and water chemistry data are all incorporated into a versatile relational database that is linked to the state’s geographical information system for more efficient data interpretation and program planning. Each biological monitoring site will be summarized into what is called an ecological survey report and should be posted on the programs web site within the next year.

Efforts during the first year of the DES biomonitoring program took place in the Souhegan watershed of southern New Hampshire and consisted of thirty-six macroinvertebrate samples being collected at nine locations. Since that time the program has continued to expand, increasing its sampling efforts annually.

The 1997 sampling season took place from June through October and focused predominantly on tributaries to the lower Connecticut River Basin. A total of twenty-two sites were monitored with as many as three trips to each site for collection of chemistry, habitat, fish, and macroinvertebrate data.

In 1998, the Biomonitoring Program received technical and field assistance from EPA in order to increase the total number of stations sampled to sixty. EPA assistance provided the personnel, equipment and technical support necessary to expand the scope of sampling in support of generating biological data required for the development of numerical biocriteria specific to New Hampshire. Selection of the 1998 biomonitoring sites was focused upon generating a sample set of stream reaches that would reflect reference conditions for each particular stream reach. Sites were selected for biomonitoring efforts in 1998 from the Upper Connecticut, Saco, Androscoggin and Piscataqua River basins.

Program planning for 1999 and 2000 revolves around another collaborative biomonitoring effort between EPA and DES during 1999 with sixty reference sites targeted within the Lower Connecticut, Merrimack and Piscataqua River basins. Projected sampling efforts for the Biomonitoring Program in 2000 will focus upon sampling several reference sites within the White Mountain National Forest boundaries to increase the geographic distribution of biomonitoring data collected from pristine stream reaches. Additional efforts in 2000 will attempt to locate and sample streams within the Piscataqua and Merrimack River basins that have documented detrimental impacts to the aquatic habitat or surface water quality. It is hoped that the biomonitoring data collected in 2000 will correlate with available land use information as well as habitat assessment data collected on site to begin the process of screening particular biometrics for inclusion in the development of numeric

biocriteria for New Hampshire.

Other ongoing efforts will include participation in ecological risk assessment efforts at state and federal superfund sites and the continued coordination and monitoring effort designed to investigate the amphibian malformation issue in the state of New Hampshire.

1.6 FISH/SHELLFISH TISSUE MONITORING

Monitoring of fish tissue in the State is primarily conducted by the Department of Health and Human Services (DHHS), Division of Public Health Services. The primary purpose of analyzing fish tissue for various pollutants is to determine if there is risk to public health if the fish are consumed. Health risk assessments are conducted by the DHHS, who are also responsible for issuing fish consumption advisories where necessary.

Fish tissue analyses are typically done for special projects where there is a perceived or potential problem. However, DHHS also, performs tissue analyses on random samples of fish caught from different surface waters of the State, as long as funding is available. As of the end of 1999, 640 individual analyses of mercury in freshwater fish were in the DES database, and most of these were analyzed by DHHS. More information regarding fish/shellfish tissue sampling and fish consumption advisories may be found in Part III, Chapter 8.

On occasion, DES also conducts fish tissue analyses for specific projects such as the one on Kezar Lake, where fish tissues were tested for aluminum. Fish tissue analyses are also being done by the DES biomonitoring program to support Superfund and hazardous waste ecological risk assessment efforts. From 1992 to 1993, DES also participated in the International Toxics Monitoring Program (ITMP) which was a joint effort of the Canadian Eastern provinces, the New England States and New York. The purpose of this two year program, was to gather data to assist in determining the extent of toxics contamination of eastern fresh water fish species and to investigate possible sources of the contamination. In each participating State or province, fish samples from selected lakes, as well as snow pack samples from the drainage basins, were collected and analyzed (by the Maine Department of Environmental Protection) for mercury, arsenic, lead and cadmium. In New Hampshire, six lakes were tested as part of this program.

DES also assists the DHHS with collecting fish samples for tissue analyses. Beginning in 1995, DES through the Volunteer Lakes Monitoring Program (see Part III, Chapter 5), requested volunteers to freeze fish they have caught and to bring them to DES. The fish are then turned over to the DHHS, for analysis. This is an inexpensive way of obtaining a more diverse cross section of fish from throughout the State.

In coastal waters, much work has been conducted to determine contaminant concentrations in mussels, oysters, lobster, and winter flounder with the greatest amount of information being available for blue mussels. A thorough review of these studies is available in a characterization study done by University of New Hampshire, Jackson Estuarine Laboratory for the NH Estuaries Project (Jones, 1997-draft). Included is a summary of contaminant concentrations in blue mussel tissue samples taken on or near the New Hampshire coast. Tested contaminants include silver, aluminum, arsenic,

cadmium, chromium, copper, iron, mercury, nickel, lead, zinc, PCBs, PAHs, and chlorinated pesticides.

Historically, the DHHS and NHFG have collaborated on testing shellfish waters for the presence of Paralytic Shellfish Poisoning (PSP) toxin. The monitoring program has consisted of weekly collection of mussels from Hampton/Seabrook Harbor for the period of April to October (note that depending on actual PSP levels and other factors, monitoring would occasionally be stepped up to twice per week). Data sharing with Maine and Massachusetts has been, and will continue to be, an integral part of the weekly PSP monitoring.

Mussels are the target species because studies have shown that they tend to accumulate the toxin more quickly than other shellfish species, and therefore are regarded as the best species to provide an "early warning" of dangerous PSP levels. Mussel tissue is analyzed in Concord by the DHHS Public Health Laboratory.

For the year 2000, monitoring at the Hampton/Seabrook station will continue. Samples will be collected by the NHFG. With funding provided by the New Hampshire Estuaries Project, another PSP monitoring station will be added. Although the final site location has not been determined, it will most likely be located at Star Island, Isles of Shoals. Data from this site will provide valuable information on the presence and duration of PSP blooms in the offshore waters, which is where such blooms tend to originate. If this site is selected, monitoring would still be spring to fall, but transportation costs to the site may limit the monitoring to a May-September scenario.

1.7 SEDIMENT TESTING

DES does not perform routine testing of surface water sediments. Sediment testing has, however, been occasionally conducted over the years by DES, or others, as part of other programs or projects. For the most part, sediment testing is done where there is a perceived or potential problem or when it is necessary to accomplish the objectives of a particular study. For example, sediment testing was conducted by DES biologists in 1993 at three marinas in the Lake Winnipesaukee Watershed as part of the Section 319 program. Samples were analyzed for VOC's and bulk sediment toxicity tests were performed using a benthic worm (Chironomus tentans) as the test organism. As part of the Clean Lakes Program, DES has also performed tests on sediment from Kezar Lake and other surrounding lakes, to determine aluminum levels. Sediment testing (both chemical and biological) is also conducted in the REMAP mercury project and in the Paleolimnological/Bioassessment project. Additional information on lake studies can be found in Part III, Chapter 5.

Limited sediment testing has been conducted in the Merrimack River in 1992 by consultants working on the combined sewer overflow (CSO) abatement plan for the City of Manchester. For this study, Toxicity Characteristic Leachate Procedure (TCLP) tests were conducted on sediments in the vicinity of CSOs to determine if they were hazardous.

In tidal waters, many studies have focused on contaminants in sediments. A review of these studies may be found in the characterization study prepared by the University of New Hampshire, Jackson Estuarine Laboratory for the NH Estuaries Project (Jones, 1997- draft). According to the

characterization study, a comprehensive database for contaminated sediments in coastal New Hampshire areas has been compiled by the U.S. Geologic Survey (USGS) and will soon be available on CD and throughout the Internet. The database includes data from 199 samples in New Hampshire, 452 samples from Maine and 993 samples from U.S. Army Corps of Engineers permit applications and federal navigation projects.

PART III, CHAPTER 2

PLAN FOR ACHIEVING COMPREHENSIVE ASSESSMENTS

2.1 INTRODUCTION

EPA has established a long-term goal of comprehensively characterizing surface and groundwaters of each State. To help ensure national progress toward this goal, EPA has requested each State to include in its water quality report a section on what is necessary to achieve comprehensive monitoring and assessments of its waters. This chapter is provided in response to EPA's request.

2.2 COMPREHENSIVE MONITORING PLANS

2.2.1 Rivers and Streams

As discussed in Part III, Chapter 4, approximately 25 percent of the rivers and streams in New Hampshire were considered assessed this year if the mercury fish advisory is excluded. This is based on EPA guidance which recommends that each sampling station should represent no more than 25 miles of rivers.

One way to increase the number of assessed miles is to increase the number of sampling stations. This, however, can be very costly. For example, in 1997 the DES Surface Water Quality Bureau developed a draft "Strategic Monitoring Plan" for rivers and streams. The purpose of this plan was to offer solutions to perceived shortcomings on the existing ambient monitoring program and to recommend amendments to the program to accommodate EPA monitoring requirements. A copy of the plan is included in Appendix B. The plan concludes that to conduct additional physical/chemical monitoring and Whole Effluent Toxicity (WET) tests on rivers and streams in accordance with EPA guidance, will require an additional $185,000 per year or more over and above the costs of the existing ambient sampling program. The plan assumes samples are taken on a quarterly basis and that sampling stations are located no more than 25 miles apart. It did not include additional biomonitoring stations.

A more cost effective way to increase the number of assessed miles is to develop and implement a probability based monitoring program (PBMP). The benefit of a PBMP is that it provides a statistically defensible basis for calling more rivers assessed without having to actually monitor them. That is, it allows statistically valid inferences to be made from rivers that are monitored to rivers with similar characteristics that are not monitored.

Since the last report, DES, with assistance from EPA, has been investigating the design of a PBMP for rivers and streams. One drawback, however, which soon became apparent was a lack of practical guidance to assist States with designing a PBMP and how it should be used for 305(b) reporting purposes. To help fill this void, EPA intends to issue draft guidance in the fall of 2000. Consequently, design of a PMBP for rivers and streams in New Hampshire is temporarily on hold pending release of the guidance manual and its recommendations.

With regards to federal funding needed, it is not known at this time how much a PBMP will cost. As reported in 1998, and as shown below, current monitoring programs rely on approximately $210,000 of federal funds each year. These programs, which are discussed in Part III, Chapter 1, include an ambient monitoring program which collects physical/ chemical and bacteriological data, a biomonitoring program and a Volunteer River Assessment Program (VRAP). It is expected, however, that even with implementation of a PBMP, more federal funding will be needed for monitoring before it can be stated that all rivers and streams have been assessed in accordance with EPA guidance.

Existing Monitoring Programs	*Approximate 1998 Federal Funding*
Ambient Monitoring Program:	$ 45,000/ year
Biomonitoring Program:	$140,000/ year
VRAP:	$ 25,000/ year
	Total : $210,000/ year

2.2.2 Lakes

Overview

DES has a number of lake monitoring programs which are briefly described in Part III, Chapter 5. The Lake Trophic Survey Program (*Lake Surveys*) provides data for the greatest number of lakes. The program was initiated in response to the passage of the Federal Water Pollution Control Act Amendments of 1972, and specifically the Section 314 requirement that each state shall classify according to trophic condition all freshwater lakes.

Under this program, New Hampshire has sampled essentially all accessible lakes and ponds. The issue of determining the number of lakes available to sample is discussed in Part III, Chapter 5. Although we indicate that 161 waterbodies exist that have not been inventoried, these are primarily wetlands, run-of-river impoundments, or remote, inaccessible ponds. DES will continue to work on assessing the significance of these waterbodies, but have serious concerns about directing resources toward sampling wetland type ponds supporting little or no human use.

Because all lakes and ponds have been essentially sampled, there is no need and, consequently, no plans to establish a probabilistic sampling program. Recognizing that lakes in general change very slowly, it is not necessary to sample them every five years (EPA's definition for monitored waters) to assess use support. All lakes are assessed every two years using the most recent data, and we are confident (based on report surveys) that up to at least 10 year old data accurately reflects existing

conditions in most cases (within the limits of the sampling protocol).

Future Monitoring Plans

It should first be recognized (as also discussed in Part III, Chapter 5) that with the elimination of funding for the Clean Lakes Program, DES has one federally-funded staff assigned to the lakes program (compared to 3 ½ staff in the past). This staff person is not involved in routine lake monitoring, but directs the field work for special lake studies (e.g., the paleolimnological/bioassessment of lakes project and the REMAP project on mercury in lakes and lake sediments) and 319 implementation projects at lakes. These projects were identified as high priority projects in the EPA Performance Partnership Agreement work plan. *All lake assessment monitoring is carried out by state-funded staff with some federal support for related expenses (interns, supplies, equipment).*

As a result of no federal Clean Lakes funding, more emphasis has been placed on volunteer monitoring. Future monitoring plans will continue to emphasize the use of volunteer monitors. At the very least, lakes with active and interested lake associations on them will continue to be monitored. Along with the volunteer program, we will continue the state-funded acid rain, swimming beach and fish-mercury monitoring programs, and will continue the lake trophic surveys, albeit at a reduced rate based on available resources.

As a result of past and existing lake monitoring programs, DES has an excellent database of water quality (chemical and biological) and morphological data for New Hampshire lakes and ponds. Immediate future plans are to continue to update the database with newly collected data as discussed above. Longer-term plans are to link the lake data with GIS capability to allow for mapping of lakes, watersheds and watershed activities. DES is also involved in creating a joint website for water quality data with the University of New Hampshire.

2.3 GEOREFERENCING

Georeferencing or reach indexing is the process of electronically linking a State's waterbodies and other water quality information to the EPA Reach File (RF3). By 1999, EPA plans on incorporating RF3 into a new National Hydrography Dataset (NHD), which will become the official hydrologic database for EPA, USGS and other agencies. RF3 files are currently at a scale of 1:100,000, which is the scale EPA is currently using to track and display water quality issues on a national level.

With assistance from Research Triangle Institute (RTI is a contractor for EPA), significant progress has been made to georeference all surface waters in the State. To date, all rivers and streams in New Hampshire have been assigned a waterbody identification number and mapping of rivers and streams at the RF3 level is nearly complete. Lakes, however, have not been georeferenced to RF3. DES has provided latitude and longitude information for the lakes to RTI to allow them to locate the lakes in the RF3 file system.

In January of 2000, the University of New Hampshire Complex Systems Research Center (CSRC) entered into a contract with the New England Interstate Water Pollution Control Commission (NEIWPCC) to generate hydrographic centerlines for New Hampshire at a scale of 1:24,000. This data layer, which is expected to be completed by 2001, will be part of the NH GRANIT database and will available to DES as well as the community of GIS users in the State. In the future, DES intends to use this layer for 305(b) reporting purposes including the estimation of total waters and georeferencing of water quality information.

PART III, CHAPTER 3

ASSESSMENT METHODOLOGY

3.1 INTRODUCTION

This chapter includes a discussion of the assessment methodology used to make use support decisions for rivers, streams, estuaries and coastal waters. The assessment methodology for lakes is covered in Part III, Chapter 5.

First discussed in Section 3.2, is the procedure used to develop the list of "impaired" waters which are not considered to fully support all designated uses. This is followed by Section 3.3, where definitions and discussions of the various terms used in the assessment tables are reviewed. Finally, a discussion of the status of DES efforts to perform electronic assessments is included in Section 3.4.

3.2 PROCEDURE FOR DEVELOPING THE 305(b) LIST

Prior to making use support decisions, it is first necessary to develop a list of waters which are considered to be impaired; that is, they are not considered to fully support all designated uses. This list, called the "305(b) List" is the basis of the water quality assessment. The 305(b) List for rivers, streams and tidal waters (estuaries, open ocean and coastal shoreline) is provided in Appendix C. It includes the location of impairment, the cause of impairment, the probable source of impairment, the estimated miles (or square miles) of overall and individual use support, and recommended abatement action. For rivers and streams, the list is arranged by water basin. Separate tables are provided for the tidal waters.

To develop the 2000 305(b) List for rivers, streams and estuaries (Appendix C), water quality information from a variety of sources was assembled and reviewed. Sources include the DES Ambient Monitoring Program, the DES Nonpoint Source Program, the DES Coastal Shellfish Program, the New Hampshire Estuaries Project, the New Hampshire Department of Health and Human Services, the U.S. Fish and Wildlife Service, the National Resource Conservation Service, the United States Geological Survey, and various volunteer monitoring groups. Information obtained by DES and from the above agencies was then incorporated into the 2000 305(b) List if supporting data was supplied which indicated an exceedance or a violation of New Hampshire water quality standards.

3.3 DEFINITIONS

3.3.1 Purpose

The purpose of this section is to define the many terms used to develop the following four types of use support summary tables for rivers and streams, estuaries and coastal waters, as required by EPA.

- Summary of Fully Supporting, Threatened and Impaired Waters
- Individual Use Support
- Waterbodies Not Fully Supporting Uses by Various Cause Categories
- Waterbodies Not Fully Supporting Uses by Various Source Categories

Definitions of terms used to develop similar tables for lakes may be found in Part III, Chapter 5. Use support tables for wetlands were not developed because of a lack of ambient data and the fact that numeric water quality standards specific to wetlands have not yet been developed (see Part III, Chapter 7). Where needed, further explanation is provided after the definitions for each table under the heading "Discussion".

3.3.2 Terms Used in Summary Tables of Fully Supporting, Threatened and Impaired Waters

The summary tables of fully supporting, threatened and impaired waters provide a general indication of the overall quality of the State's surface waters. The following definitions apply to these tables.

Fully Supporting:

All individual uses are defined as being fully supported for reasons discussed in Section 3.3.3; there are no known exceedances of State Water Quality Standards.

Partially Supporting:

One or more uses are defined as being partially supported for reasons discussed in Section 3.3.3; all other uses are fully supported.

Not Supporting:

One or more uses are defined as being not supported for reasons discussed in Section 3.3.3.

Monitored- Fully Supporting (minimum data requirements):

Waters where ambient water quality information collected within the past five years (1995-1999) indicates that the water is fully supporting of swimming and aquatic life uses. For freshwater rivers and streams, the minimum data required to be considered monitored and fully supporting was bacteria and biomonitoring/habitat assessment information and for tidal waters, bacteria and physical/chemical data was required.

Monitored - Impaired (minimum data requirements):

Waters where ambient water quality information collected within the past five years (1995-1999) indicates that the water is impaired for any use.

Evaluated - Fully Supporting (minimum data requirements):

Freshwater rivers and streams:

Bacteria information which was collected in the past six to ten years (1990 - 1994) and,

Biomonitoring/habitat information which was collected in the past six to ten years (1990 - 1994) or physical/chemical data which is less than ten years old (1990 - 1999).

In addition to the above, waters of national forests, which are considered Outstanding Resource Waters (ORW), were considered evaluated - fully supporting unless data was available which indicated impairment.

Tidal Waters:

Bacteria and physical/chemical information which was collected in the past six to ten years (1990 - 1999).

Evaluated - Impaired (minimum data requirements):

Waters where impairment is based on information other than current site-specific ambient monitoring data. This includes ambient monitoring data that is more than five years old or information other than ambient monitoring data which suggests that the water is impaired.

Assessed:

Waters where there is adequate monitored or evaluated water quality information (as defined above) to make use support decisions. Assessed waters equal the sum of monitored and evaluated waters. In general, monitored assessments are considered more reliable than evaluated assessments because the ambient data and information used to make monitored assessments is more current and complete.

Not Assessed:

Waters where monitored or evaluated information water quality information (as defined above), was not available to make use support decisions.

Discussion:

The methodology used to determine whether *impaired* waters were either monitored or evaluated is similar with that used in the 1998 report. The same is true for the methods used to assess tidal waters.

Monitored - Fully Supportive Rivers and Streams: Similar to the 1998 report, rivers and

streams were considered monitored- fully supporting if bacteria (to determine if the swimming use was met) and biomonitoring/habitat data (for aquatic life use support decisions) was available which was no more than five years old and met water quality standards. Physical/chemical data for ALUS decisions were not defined as monitored because biomonitoring/habitat data is considered by many, including EPA, to be a better indicator than physical/chemical data of the actual health of a waterbody. This is especially true in moving systems such as rivers and streams where physical/chemical measurements typically represent only a snap shot in time compared to biomonitoring/habitat assessments which represent the long term effects of pollutants.

Evaluated- Fully Supportive Rivers and Streams: As reported in 1998, rivers and streams were considered evaluated and fully supportive of the fishable/swimmable uses if the following was available: ambient bacteria data that is more than five years old but less than ten years old combined with biomonitoring/habitat information which is more than five years old but less than ten years old or physical/chemical data which is no more than ten years old Physical/chemical data, though not always as conclusive as biomonitoring/habitat data, was considered sufficient to make evaluated assessments as long as the data was no more than ten years old. Based on discussions with EPA, an upper limit of ten years for data age was established in an attempt to guard against making assessments based on outdated data. Rivers and streams with data over ten years old, which show no impairment, are considered not assessed.

In most cases, ambient data is needed to make evaluated assessments. As reported in 1998, the exception to this are waters in the national forests which are considered Outstanding Resource Waters (ORW). Unless there was data suggesting impairment, rivers and streams in the national forests were considered to be assessed (evaluated - fully supporting) since most are headwater streams and because there is little to no development or human impact in these areas.

Coverage per station: According to EPA guidance, " a monitoring station can be considered representative of a stream waterbody for a distance upstream and downstream that has no significant influences that might tend to change water quality and habitat quality." Examples of significant influences include the following:

* point or nonpoint source input to the waterbody or tributaries;
* a change in watershed characteristics such as land use;
* a change in riparian vegetation, stream banks, substrate, slope, or channel morphology;
* a large tributary or diversion, and;
* a hydrologic modification such as channelization or a dam.

In general, EPA recommends that wadable streams represent no more than five to ten miles of stream and for large rivers, 25 miles is considered by EPA to be a reasonable upper limit. Based on this, and as reported in 1998, the following was used as guide for determining the extent of coverage per station on rivers and streams. A distinction was made between urban and rural areas to account for the increased potential that a waterbody will become impaired as population and development in the watershed increases.

Land Use	Coverage per station
Urban Area (Rivers and Streams)	≤ 5 Miles
Rural Area (Streams)	≤ 10 Miles
Rural Area (Rivers)	≤ 25 Miles

3.3.3 Terms Used in Individual Use Support Summary Tables

The Individual Use Support summary tables show a breakdown of the total size of each waterbody type that is fully, fully supported but threatened, partially or not supporting for each use. Uses include swimming, aquatic life support, drinking water supply (public water supplies only), fish consumption, and shellfishing (tidal estuaries and coastal waters only). For rivers and streams, estuaries and coastal waters, the summary tables are based on the 305(b) List included in Appendix C. The following discussion explains how use support decisions were made for each individual use.

Use - Swimming (Primary Contact Recreation):

- **Fully Supporting (Swimming):**

  1) Bacteria:

  There are no confirmed exceedances of the State bacteria standards

  2) Bathing Area Closures:

  There are no known beach closures or restrictions in effect during the reporting period.

  3) Nuisance Plant Growth:

  There are no algal blooms or macrophyte growth that interfere significantly with swimming.

- **Partially Supporting (Swimming):**

  1) Bacteria

  a) The source of bacteria is from combined sewer overflows (CSOs) or separated stormwater.

  b) The source of bacteria is from natural sources.

  c) There are confirmed fecal coliform measurements in freshwater that are not due to natural sources which exceed the State single sample standard for E. coli of 406 per 100 ml.

2) Bathing Area Closures:

a) On the average, there is no more than one bathing area closure per year of less than one week's duration.

b) The bathing area closures are due to natural sources or heavy swimming activity.

3) Nuisance Plant Growth:

a) Frequent and persistent algal blooms and/or excessive native macrophyte growth and/or exotic macrophyte growth occur that interfere significantly with swimming.

C **Not Supporting (Swimming):**

1) Bacteria:

There are confirmed violations of the State's bacterial standards as defined below;

a) in freshwaters, there are more than 406 E. coli per 100 ml in any one sample or greater than 88 E. coli per 100 ml. in any single sample at designated swimming areas; or

b) in tidal waters used primarily for swimming, there are more than 104 Enterococci per 100 ml. in any one sample.

2) Bathing Area Closures:

On the average there is one bathing area closure per year of greater than one week's duration, or more than one bathing area closure per year and the closures are not due to natural sources or heavy swimming activity.

Use - Aquatic Life Support

C **Fully Supporting (Aquatic Life):**

1) Conventionals: Dissolved Oxygen (DO) and pH:

There are no confirmed violations of State DO or pH water quality standards.

2) Toxicants:

a) There are no confirmed exceedances of any of the water quality criteria for toxics listed in the State's Surface Water Quality Regulations (see Appendix A).

b) There are no known confirmed exceedances of Whole Effluent Toxicity (WET)

tests which show that the surface water itself is toxic.

3) Bioassessments:

Results based upon the New York Department of Environmental Conservation (NYDEC) bioassessment model are greater than a 64 percent model affinity, a taxa richness of at least 15, an EPT (Ephemeroptera, Plecoptera, and Trochoptera) value greater than 10 exists, and a habitat value of at least 150 was recorded for the site.

4) Habitat:

Professional observations and/or habitat assessment scoring indicate naturally occurring stream morphology, substrate composition, natural riparian physical and vegetative structure and stability, flow regime, and minimal to no anthropogenic influences within a spatial range that could induce stressed or impaired habitat conditions.

C **Partially Supporting (Aquatic Life):**

1) Conventionals: Dissolved Oxygen (DO) and pH:

a) DO: There are one or more confirmed exceedances of the State DO standard (i.e., average daily DO is less than 75 percent of saturation but the minimum DO concentration is greater than or equal to 5 mg/l).

b) pH: There are one or more confirmed exceedances where the pH was less than 6.5 but more than 6.0 or more than 8.5 but less than 9.0.

c) The pH or DO exceedance is due to natural sources.

2) Toxicants:

a) There are one or more confirmed exceedances of any of the water quality criteria for toxic substances listed in the State's Surface Water Quality Regulations (see Appendix A).

b) Results of Whole Effluent Toxicity (WET) tests of the surface water itself indicate that aquatic organisms may be adversely affected.

c) Exceedances of water quality criteria for toxics is due to natural sources.

3) Bioassessments:

Results based upon the NYDEC model ranges from 35-64 percent model affinity,

taxa richness ranges from 5-15, EPT values range from 2-10, and the habitat assessment scores range from 50-150.

4) Habitat:

a) One or more habitat parameters fall into the "marginal" habitat condition category and are caused by obvious non-naturally occurring influences while demonstrating obvious chronic impairment.

b) Documented cases of significant erosion exist.

C **Not Supporting (Aquatic Life):**

1) Conventionals: Dissolved Oxygen (DO) and pH:

a) DO: The minimum DO concentration is less than the State standard of 5 mg/l and it is not attributable to natural causes.

b) pH: There are one or more confirmed exceedances where the pH was less than 6.0 or greater than 9.0 and the source is not due to natural sources.

3) Bioassessments:

Results based upon the NYDEC model shows a percent model affinity less than 35, EPT is less than 2, taxa richness is less than 5 (one or two pollutant tolerant taxa are likely to be extremely abundant) and the habitat assessment value is less than 50.

4) Habitat:

Several habitat parameters fall into the "poor" habitat condition category and are caused by obvious and severe non-naturally occurring influences. Biological data results are supportive of this designation by demonstrating a severely impacted biological community of fish, invertebrates, or both.

Use - Fish/Shellfish Consumption:

C **Fully Supporting (Fish/Shellfish Consumption):**

No fish or shellfish " restricted consumption" or "no consumption" advisories or or bans are in effect.

C **Partially Supporting (Fish/Shellfish Consumption):**

"Restricted consumption" advisories are in effect where restricted consumption is defined as limits on the number of meals or size of meals consumed per unit time for one

or more fish/shellfish species or a fish or shellfish ban is in effect for a subpopulation that could be at potentially greater risk for one or more fish/shellfish species.

C **Not Supporting (Fish/Shellfish Consumption):**

A "No consumption" of fish or shellfish advisory or ban is in effect for the general population, for one or more fish/shellfish species; or a commercial fishing/shellfishing ban is in effect.

Use - Drinking Water:

C **Fully Supporting (Drinking Water):**

Finished Water: In the finished (treated) drinking water there have been no contaminants with confirmed exceedances of the (Safe Drinking Water Act) SDWA standards other than occasional bacteria exceedances associated with operator or equipment failure.

Restrictions: There have been no source water closures, no advisories which have lasted more than 30 days per year and no source waters which have required more than conventional treatment to enable drinking water uses.

C **Partially Supporting (Drinking Water):**

Finished Water: In the finished (treated) drinking water there have been no contaminants with confirmed exceedances of the SDWA standards other than occasional bacteria exceedances associated with operator or equipment failure.

Restrictions: There have been one or more drinking water source advisories lasting more than 30 days per year or one or more source waters that have required more than conventional treatment to enable drinking water uses due to contaminants in the source water that may adversely affect treatment costs or the quality of finished water (e.g. due to taste, odor, turbidity, dissolved solids, etc.)

C **Not Supporting (Drinking Water):**

Finished Water: In the finished (treated) drinking water there have been one or more contaminants with confirmed exceedances of the SDWA standards (other than occasional bacteria exceedances associated with operator or equipment failure).

Restrictions: There have been one or more contamination based closures of a drinking water source.

Discussion:

Swimming (Primary Contact Recreation): State Statute RSA 485-A:8 I, II, and V include bacteria limits to protect swimming and other forms of primary contact recreation. For freshwaters, the bacterial standards are based on E. coli, while for tidal waters the limits are based on enterococci. A copy of these statutes may be found in Appendix A.

The definitions for swimming use support based on bacteria are the same as those used in 1998, wherein confirmed (i.e., samples were collected and analyzed using proper QA/AC protocols) exceedances of the single sample bacteria criterion were once again considered to be not supporting of swimming. It was decided to base impairment on single sample bacteria standards because a sufficient number of samples is generally not available to allow comparison to the geometric mean standard which are less than the single sample criterion. As indicated in Appendix A, State law specifies single sample bacterial limits as well as limits based on a geometric mean of at least three samples collected over a 60 day period. At most sites, only one to three bacteria measurements are typically made and they are not always within the 60 day time frame. In the few instances where sufficient data was available, the geometric mean was calculated. If the geometric mean violated the water quality standard, the waterbody was considered to be not supporting.

In some ways, this definition is more stringent than the EPA definition which recommends that exceedances of single sample criterion be categorized as partially supporting and that exceedances of the geometric mean be considered not supporting. On the other hand, this definition is less stringent than EPA's because it is possible for a waterbody to meet the single sample criterion but exceed the geometric mean standard. In such a case, the waterbody would be considered not supporting by EPA's definition and fully supporting using the definition in this report. It is hoped that future use support decisions will be based on definitions similar to those recommended by EPA. This however is contingent on resources and the ability to collect enough samples that would consistently allow comparison of bacteria results to both the single sample and geometric mean bacteria standards.

Similar to the 1998 report, exceedances due to natural (i.e., non-human) sources are considered partially supporting. As previously mentioned, pre-1998 reports did not consider such waters to be impaired because State law allows exceedances of the bacteria standards if they are naturally occurring. This decision is based on discussions with EPA who believe that it is appropriate to report natural exceedances as impairments even if such exceedances are not considered to be water quality violations by State law.

As in 1998, areas affected by bacteria from combined sewer overflows (CSOs) were considered to be partially supporting for swimming. This recognizes the fact that a portion of CSOs includes raw municipal wastewater which contain human feces and can cause temporary exceedances of the bacteria standards, but that CSOs occur only during wet weather (i.e., during periods of rain or snowmelt) when waters are not generally not used for primary contact recreation such as swimming. In a sense, therefore, bacteria from CSOs pose less of a health risk to the general public than bacteria which is present during dry weather, because CSOs do not occur at times when people are most likely to be swimming. Because of this, waters affected by bacteria from CSOs were considered to be partially supporting instead of not supporting.

Similar to the 1998 report, and for reasons similar to those for defining bacteria exceedances from CSOs as partially supporting, bacteria exceedances due to separated stormwater were also considered to be partially supporting. Prior to 1998, wet weather exceedances due to separated stormwater were not included in the assessments. This was because of questions regarding the applicability of the current bacteria standards to separated stormwater. That is, because the bacteria in separated stormwater does not originate from human feces and because the exceedances are short term events that occur during wet weather when activities such as swimming, are less likely to occur, the risk to public health may be less than suggested by the current bacteria standards. That is, higher bacteria standards may be appropriate for separated stormwater. Although these questions remain unanswered, bacteria exceedances due to separated stormwater are now considered to be partially supporting.

As reported in the past, freshwaters where fecal coliform measurements exceeded the single sample E. coli standard were also defined as being partially supporting for swimming. This was done because fecal coliform measurements can sometimes closely approximate the number of E. coli. High fecal coliform counts can therefore indicate a potential threat to public health. However, since State law is based on E. coli for freshwaters, and since fecal coliform counts are not always equal to the number of E. coli, such waters were categorized as partially supporting instead of not supporting.

The definitions based on bathing area closures are the same as those used in the 1998 report. Bathing area closures due to natural sources or heavy swimming loads were defined as impaired but partially supporting. The decision to include natural and heavy swim loads as sources of impairment was based on recommendations made by EPA who believe that the source of impairment is irrelevant when making use support decisions.

Similar to 1998, nuisance plant growth was also used to assess the swimming use in rivers, streams and coastal waters. Impairment due to nuisance plant growth was considered partially supporting instead of not supporting because it is primarily an aesthetic issue and not a public health concern.

Aquatic Life: Prior to 1998, aquatic life use support (ALUS) decisions were based primarily on physical/chemical analyses of conventional and toxic pollutants which were collected as part of the ambient monitoring program or other studies. Since 1998, however, bioassessment and habitat information has been used for determining if aquatic life use was supported or impaired. This is discussed below.

In the past, sampling results for dissolved oxygen (DO), pH and various metals have been primarily used for making ALUS decisions. As mentioned in Part III, Chapter 1, sampling is usually conducted during the low flow summer months. At each of approximately 100 sampling stations, three DO and pH readings and one sample for metals analyses are typically taken each year.

With regards to DO, RSA 485-A:8, II, (see Appendix A) and the Surface Water Quality Regulations (Appendix A), require that all Class B waters have a minimum average daily DO of at least 75 percent of saturation, and a minimum instantaneous DO of 5.0 mg/l, unless naturally occurring. At a water temperature of 25E C, 75 percent of the DO saturation value corresponds to approximately 6.1

mg/l. ALUS decisions based on DO are similar to the 1998 305(b) report. Waters with DO exceedances due to natural sources are considered impaired but partially supporting for reasons similar to those presented in the section above for the swimming use support. A surface water was categorized as fully supporting if the DO was greater than or equal to 75 percent saturation and not supporting of aquatic life if the measured DO in any sample was less than 5 mg/l. Surface waters were categorized as partially supporting if the DO was greater than 5 mg/l but less than 75 percent saturation (on an average daily basis). The above definition was primarily applied to all DO measurements taken in rivers and streams and in the upper 25 percent of the total depth of impoundments which were not addressed in the assessment performed for lakes and ponds.

The definition of DO based, partially supporting waters should be interpreted to mean that DO exceedances exist and there is a potential or minimal impact on aquatic life. Similarly the definition of DO based, not supporting waters should be interpreted to mean that State DO criteria have been exceeded and there is a greater potential or a more significant impact on aquatic life.

With regards to pH, State law (RSA 485-A:8, II) requires all Class B waters to have a pH in the range of 6.5 to 8.0 except when due to natural causes. Similar to DO, the definitions for pH this year are the same as in 1998. Excursions of pH due to natural sources are considered partially supporting, even though State law allows naturally occurring exceedances. The more the pH deviates outside of the range, the greater the potential for harm to the aquatic life. The definition for nonsupporting surface waters (pH of less than 6.0 or more than 9.0) was based on information provided in the EPA Gold Book (USEPA, 1986). Partially supporting waters were consequently defined as those which had a pH which fell within the ranges used to define full and nonsupport or where the source of pH exceedance was due to natural sources.

State rules and regulations concerning toxics in surface waters are reviewed in Part III, Chapter 8. In general, the State's Surface Water Quality Regulations (see Appendix A) require that all waters shall be free from toxic pollutants that injure or are inimical to aquatic life or that persist in the environment or accumulate in aquatic organisms to levels that result in harmful concentrations in edible portions of fish, shellfish, other aquatic life, or wildlife which may consume aquatic life.

The Surface Water Quality Regulations (Appendix A) also include chronic and/or acute numeric limits or criteria for 129 toxic substances. Prior to 1998, in-stream measurements of potential toxics were compared only to the acute criteria for making aquatic life support decisions based on toxics. Comparison to acute limits was selected because sufficient data was usually lacking to compare results to the chronic level. That is, usually only one grab sample is taken at each site for analysis of toxicants such as metals. In the past this was not considered adequate for comparing to the much lower chronic criteria which are based on four day exposure periods. According to the most recent EPA guidance, however, four day composite samples are not an absolute requirement for evaluating chronic criteria. Grab and one day composites can be used if taken during stable conditions. As was done in 1998, and to be more in accordance with EPA guidance, acute criteria as well as chronic criteria (where appropriate) were used for determining impairment due to toxicants.

Violations of acute water quality criteria may not actually mean there are in-stream aquatic life impacts. As discussed in Part III, Chapter 8, reasons for this include the fact that the criteria are based

on laboratory studies that do not take into account site specific factors that may render a substance less toxic in a waterbody. Furthermore, for determining compliance with the numeric criteria, only the total concentration is used, which is equal to the sum of the particulate and dissolved fractions. In many cases, however, it is the dissolved or bioavailable fraction which has the greatest impact on aquatic organisms. For these reasons, exceedances of acute numeric criteria indicate a potential but not a definite impact on aquatic life; therefore, such waters are defined as partially supporting instead of not supporting.

As in 1998, Whole Effluent Toxicity (WET) tests were also used to assess aquatic life use support. Many NPDES facilities now perform WET tests. These laboratory tests, which are designed to simulate in-stream conditions, provide an indication of whether the receiving water by itself or when mixed with a permittee's effluent is potentially harmful to aquatic organisms. For this report, WET results that indicate possible problems in the receiving water by itself, were defined as partially supporting. Partially supporting was selected because decisions were usually based on only one test that showed a potential problem in the water, and the fact that WET tests are not as conclusive as ambient toxicity tests or biomonitoring results.

This is the second 305(b) report which has used bioassessment and habitat information to make ALUS decisions. Prior to 1998, such information was not used because it was either not available and/or because numeric biological criteria has not been established for New Hampshire. Over the past four years, DES has collected a significant amount of biomonitoring/habitat information. Although the State still does not have numeric biological criteria, it was decided to utilize a series of three metrics to make preliminary assessments in the interim. This includes a model (percent model affinity) developed by the New York Department of Environmental Conservation (NYDEC), as well as taxa richness and EPT (Ephemeroptera, Plecoptera and Trichoptera) abundance. It should be noted however, that the vast majority of sites monitored to date have been targeted reference sites, or sites that would be considered least impacted in the state. For this reason the interim numeric criteria should be used with discretion and considered provisional data until such time that stressed sites can be monitored and the models more robustly calibrated. It is likely that the definitions for ALUS based on bioassessment information will change as more data become available in New Hampshire and the results are tested more rigorously. For example, some differences are likely to exist as the NYDEC bases their results on a 100 specimen sample, whereas DES utilizes a 25% subsample (which usually accounts for more organisms). Sites that are presently listed as impaired on the current 305(b) List have been based on best professional judgement at sites that are demonstrating obvious impairment (i.e. visible sedimentation or detrimental impacts upon the biotic community).

ALUS decisions using habitat information collected when bioassessments were conducted were based on visual observations using standardized protocols and assessment sheets which

address ten specific habitat parameters for low and high gradient stream types. Each parameter was given a score from one to twenty which were then used to categorize the habitat as either optimal, suboptimal, marginal, or poor. Optimal and suboptimal habitats were considered fully supporting, marginal habitats were defined as partially supporting and poor habitats were considered not supporting of ALUS.

ALUS decisions based upon biomonitoring data found in the 1998 305(b) List were generated by substituting results of biometric results into an Impact Assessment Index (IAI), developed by the State of

Maine Department of Environmental Protection. ALUS deteminations for the current 305(b) List based upon the 1998 biomonitoring information were derived by substituting results of three biometrics as well as habitat assessment scores into a modified "O'Brien Plot" of Index Values based upon the design of the NYDEC model. This change in ALUS detemination protocols is primarily based upon the inception of the Ecological Data Application System (EDAS) within the Biomonitoring Program and the need to consider biometric data simultaneously with habitat assessment scores on the same scale.

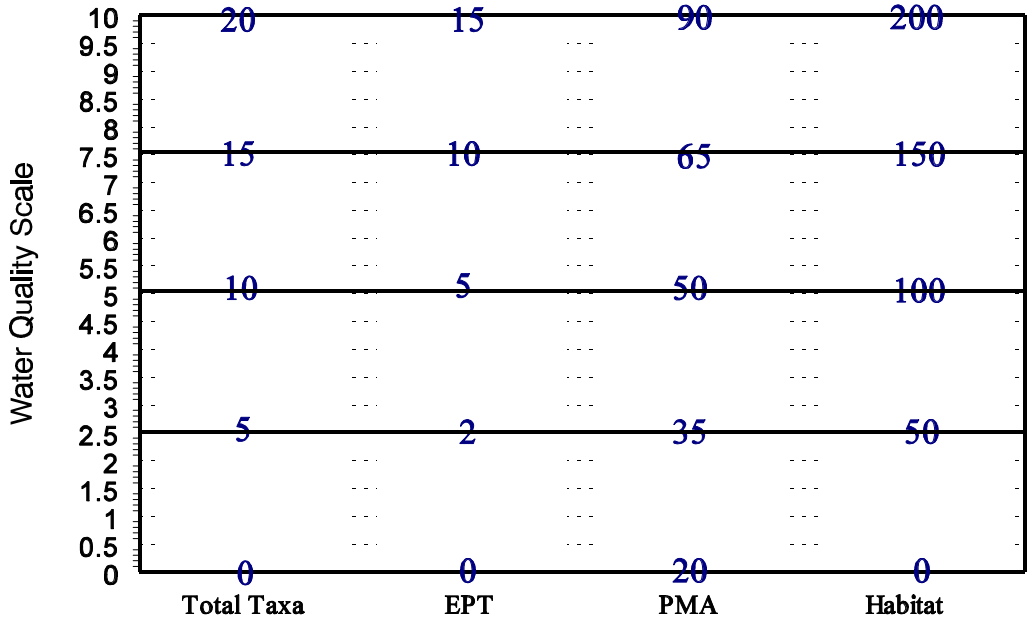
Biometric results (Taxa Richness, EPT taxa and Percent Model Affinity) from each site are plotted concurrently with habitat assessment scores along the "Y" axis of the modified "O'Brien Plot". Biometric and habitat assessment scores correlate to numerical "Water Quality Scale" values along the "Y" axis which are summed and a mean "Water Quality Scale" value is detemined for each site. The mean value is then plotted to determine ALUS. Water Quality Scale values from 7.5-10 are considered "Fully Supporting", values between 2.5-7.5 are considered to be "Partially Supporting" and values falling below 2.5 are "Non-Supporting".

The modified "O'Brien Plot" of index values, developed by NYDEC, is a method of plotting biological index and habitat values on a common scale of water quality impact. Values from the four indices are converted to a common 0-10 scale as shown in Figure III-3-1. Application of the modified "O'Brien Plot" is considered to be an interim scale for determining ALUS. The majority of sites monitored to date have been targeted reference condition or least impacted and the determinations put forth in this report should be used with discretion and considered to be provisional data. Planning for the 2000 season includes biomonitoring activities at stressed sites in order to begin developing numeric criteria specific to New Hampshire surface waters.

In addition, surface waters where there was documented evidence of habitat degradation due to erosion were also considered partially supporting this year. This is the first time that erosion has been considered as a cause of impairment and was added because of public concern over erosion on the Connecticut River where detailed erosion inventories have been conducted by the Grafton County and Coos County Conservation Districts in 1992 and 1995 respectively (GCCD et al., 1992; CCCD et al., 1995). River banks with a slight, moderate or severe ranking were classifed as partially supporting.

Fish/Shellfish Consumption: The definitions above are for the most part consistent with those recommended by EPA and the 1998 305(b) report

Figure III-3-1
Modified "O'Brien Plot" of Index Values



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Drinking Water: In New Hampshire both Class A and B waters are considered to be suitable for drinking after adequate treatment. Historically, however, Class A waters are those used as public water supplies since RSA 485-A:8, I, prohibits the discharge of sewage or wastes into these waters. In general, surface waters used solely for drinking water purposes are not monitored under the ambient program but are covered under the Safe Drinking Water Act (SDWA) requirements which are administered by DES. There are no drinking water standards for raw surface water supplies in the SDWA with the exception of those systems granted an avoidance waiver of surface water filtration. Surface water supply systems that have received this designation must meet SDWA standards for turbidity and fecal coliform in the raw surface water. To date, there are four surface water supply systems in the State which have received the avoidance designation.

The use support definitions used this year for drinking water are the same as for the 1998 305(b) report. As State law does not require that surface waters be drinkable without adequate treatment and since source water information is generally not available, assessments were based on a comparison of finished water monitoring data to the SDWA standards, and the number of drinking water supply restrictions or closures during the reporting period. The caveat was added that occasional bacteria exceedances of the SDWA standards, due to operator or equipment error, were not included in the use support decisions as such exceedances are not an indication of a polluted surface water. That is, bacteria are present in most surface waters in concentrations which exceed the SDWA standard; consequently all surface water drinking supplies should be disinfected prior to consumption, regardless of their quality. Where occasional bacteria exceedances have been observed in the finished drinking water it is usually due to inadequate disinfection, and is not believed to be

associated with a significant change in the quality of the surface water supply. Therefore such exceedances were not included in use support decisions for drinking water.

3.3.4 Terms Used in Cause/Source Summary Tables

The tables entitled "Waterbodies Not Fully Supporting Uses by Various Cause Categories" list the pollutants causing nonsupport and the total length or area of surface water impacted by each pollutant. Similarly, the tables entitled "Waterbodies Not Fully Supporting Uses by Various Source Categories" show the probable sources of pollution and the total length or area of impacted surface water attributable to each. Most terms used in the tables are self explanatory. However, the following terms, which provide a relative idea of how large a role each cause or source plays in contributing to impairment, need to be defined.

Major Contribution to Impairment:

1) It is the only cause/source responsible for nonsupport or,

2) It is one of multiple causes/ sources of nonsupport and is considered to predominate.

Moderate Contribution to Impairment:

1) It is the only cause/source for partial support, or

2) It is one of multiple causes/ sources of partial support and is considered to predominate, or

3) It is one of multiple causes /sources of nonsupport that have a significant impact on designated use attainment.

Minor Contribution to Impairment:

It is one of multiple causes/sources of nonsupport or partial support and is judged to contribute very little to nonattainment.

Discussion:

The above definitions are consistent with the 1998 EPA guidance manual and are very similar to those used in the 1998 305(b) report. These definitions, coupled with the following, explain the process used to rank causes and/or sources as either major, moderate or minor contributions to impairment.

1) Causes and sources that impact public health (i.e., drinking, swimming or fish/shellfish consumption) were assumed to predominate over those that impact aquatic life.

2) Where there were multiple causes or sources in a particular waterbody that

affected a common use, best professional judgement was used to determine which one, if any, predominated.

3.4 STATUS OF ELECTRONIC ASSESSMENTS

EPA's Waterbody System (WBS) computer program was first used by the State for tracking and reporting on the quality of the State's rivers, streams and coastal waters in 1992. Approximately 300 "waterbodies" consisting of river segments or subwatersheds, were defined. With the exception of a few of the larger lakes, New Hampshire's lakes and ponds have not yet been entered into the WBS. The WBS has not been updated since the 1992 305(b) report was completed due to a lack of resources. EPA has since developed a Microsoft Access version of the WBS program which, depending on the availability of resources, DES may decide to use in the future to submit electronic assessments.

PART III, CHAPTER 4

WATER QUALITY ASSESSMENT OF RIVERS AND STREAMS

4.1 INTRODUCTION

In this chapter, the water quality of the State's rivers and streams is discussed. In accordance with EPA guidance (USEPA, 1997), the assessment addresses the overall use support, the individual use support, as well as the causes (i.e., the pollutants) and probable sources of nonsupport. Tables are provided that summarize each of the four parts of the assessment. Definitions of the terms used in each of the assessment tables are provided in Part III, Chapter 3. Most of the information used to develop each assessment table is from the 305(b) List of potentially impaired waters included in Appendix C. For each basin, this list shows the location of each water quality violation, the cause and probable source of the violation, the estimated miles of overall and individual use support, and recommended abatement action.

4.2 OVERALL USE SUPPORT

In 1994 New Hampshire, like many other New England States, issued a statewide freshwater fish consumption advisory due to mercury levels found in fish tissue; the primary source of which is believed to be atmospheric deposition (see Part III, Chapter 8). As will be discussed in the sections that follow, when this advisory is included in the assessment, all fresh surface waters in New Hampshire are, by definition, less than fully supporting of all uses. Because New Hampshire cannot unilaterally resolve the mercury issue as a substantial amount of the mercury is not generated in-state, and to provide a more balanced or fair assessment of the State's surface waters, two assessments are provided; one which takes into account the mercury advisory and one which does not. The assessment which does not account for the mercury advisory is perhaps more meaningful because it conveys information that would otherwise be masked by the mercury advisory and, perhaps more importantly, it represents information for which DES can take corrective action , as needed.

Table III-4-l shows the overall use support for rivers and streams in New Hampshire *including* the effects of the statewide fish consumption advisory due to mercury. Similar to the 1998 305(b) Report, all rivers and streams are reported to be assessed. As shown in Table III-4-l, none of the 10,881.2 miles of rivers and streams are considered fully supportive of all uses when the effects of mercury are accounted for. This is because waters with fish consumption advisories are, by definition (see Part III, Chapter 3), either partially or not supporting of all uses, depending on the type of fish consumption advisory in effect. Consequently, since the fish consumption advisory due to mercury is statewide, none of the rivers and streams shown in Table III-4-l are categorized as fully supporting of all uses.

Table III-4-1
Summary of Fully Supporting, Threatened, and Impaired Rivers And Streams
***Including* the Effects of Mercury**

Degree Of Use Support	Assessment Basis		Total Assessed (Miles)
	Evaluated (Miles)	Monitored (Miles)	
Size Fully Supporting All Assessed Uses	0.0	0.0	0.0
Size Fully Supporting All Assessed Uses but Threatened for at Least One Use	NA	NA	NA
Size Impaired for One or More Uses	10686.0	195.2	10881.2
Size Not Attainable for Any Use and Not Included in the Line Items Above	0.0	0.0	0.0
Total Assessed	10686.0	195.2	10881.2

Notes: Only surface waters used as public water supplies were assessed for the drinking water use.
NA = Not Assessed

Table III-4-2 shows the overall use support *excluding* the effects of the statewide fish consumption advisory due to mercury. As shown, 2677.4 miles (24.6 percent) of all rivers and streams are reported to be assessed this year if the mercury advisory is excluded. Of the total assessed river miles, approximately 83.4 percent (2233.1 miles) are fully supporting and the remaining 16.6 percent (444.3 miles) are impaired for one or more uses. Table III-4-3 shows a breakdown of the overall use support by river basin. It is important to recognize that approximately 43.9% (195.1 miles) of the 444.3 miles reported as impaired are due to a fish consumption advisory for PCBs along the Connecticut River. If the Connecticut River fish consumption advisory for PCBs was excluded, 249.2 miles would be reported as impaired.

4.3 INDIVIDUAL USE SUPPORT

The estimated miles of assessed rivers and streams that are fully, partially and not supporting for each individual use, *excluding* the impacts of the statewide fish advisory due to mercury, are shown in Table III-4-4. A breakdown by river basin of the estimated miles that are not fully supporting (i.e., partially supporting or not supporting) for swimming and aquatic life support is shown in Table III-4-5. A listing of all impaired rivers and streams including the river name, location, and the miles, cause and source of nonsupport, as well as a description of activities which are underway or planned to resolve the water quality exceedances, is provided in Appendix C.

If the statewide freshwater fish consumption advisory for mercury is included, fish consumption would be the most impacted use with none of the State's river miles fully supporting this use. As shown in Table III-4-4, fish consumption is still the most impacted use even if the statewide fish advisory is excluded with a total of 278.8 miles (265.4 + 13.4) reported

Table III-4-2
Summary of Fully Supporting, Threatened, and Impaired Rivers And Streams
***Excluding* the Effects of Mercury**

Degree Of Use Support	Assessment Basis		Total Assessed (Miles)
	Evaluated (Miles)	Monitored (Miles)	
Size Fully Supporting All Assessed Uses	1814.1	419.0	2233.1
Size Fully Supporting All Assessed Uses but Threatened for at Least One Use	NA	NA	NA
Size Impaired for One or More Uses	249.1	195.2	444.3
Size Not Attainable for Any Use and Not Included in the Line Items Above	0.0	0.0	0.0
Total Assessed	2063.2	614.2	2677.4

Notes: 1) Only surface waters used as public water supplies were assessed for the drinking water use.
2) Approximately 24.6% (2677.4 / 10881.2) of all rivers and streams were assessed; 75.4% (8203.8 / 10881.2) were not assessed.
3) NA = Not Assessed

as impaired (not supporting or partially supporting) for this use. This includes 13.4 miles on the Androscoggin River where a restricted consumption advisory (RCA) due to dioxin has been in effect since 1989 and 265.4 miles on the Connecticut River where an informational health advisory (IHA) due to PCBs in fish tissue has been in effect since 1990 (see Part III, Chapter 8 for details about the fish advisories).

Table III-4-4 also shows that only 278.8 miles are reported as assessed this year for fish consumption. This recognizes the fish tissue studies done on the Androscoggin River and the Connecticut River but not the fish sampling done for mercury throughout the State in 1994 as this table excludes the effects of the statewide fish advisory due to mercury. However, as discussed in Part III, Chapter 1, it appears that there is a need for more comprehensive fish tissue testing program throughout the State that looks at a variety of possible pollutants such as PCBs and cadmium. This is especially true in the more urbanized areas of the State.

The second most impacted use, *excluding* the statewide fish consumption advisory due to mercury, is aquatic life use support (ALUS). As shown on Table III-4-4, it is estimated that a total of approximately 155.9 miles are impaired for this use with 134.2 miles being partially supporting and 21.7 miles being not supporting.

Excluding the statewide fish advisory due to mercury, the third most impacted use is swimming with a total of approximately 111.9 miles reported as impaired (43.4 miles that are partially supporting plus 68.5 miles that are not supporting).

Table III-4-3
Overall Use Support Summary For Rivers And Streams By Basin
Excluding the Effects of Mercury

Basin (Total River Miles)	Degree Of Use Support	Assessment Basis		Total Assessed (Miles)	Percent	Percent of Total Miles Which Were Assessed
		Evaluated (Miles)	Monitored (Miles)			
Androscoggin (524.9 Miles)	Fully Supporting	261.3	0.0	261.3	93.1%	
	Partially Supporting	0.0	1.0	1.0	0.4%	
	Not Supporting	4.0	14.5	18.5	6.6%	
	Total Assessed	265.3	15.5	280.8	100.0%	53.5%
Coastal - Freshwater (73.7 Miles)	Fully Supporting	0.0	0.0	0.0	0.0%	
	Partially Supporting	0.0	0.0	0.0	0.0%	
	Not Supporting	0.0	0.0	0.0	0.0%	
	Total	0.0	0.0	0.0	0.0%	0.0%
Connecticut (3526.5 Miles)	Fully Supporting	343.9	90.0	433.9	58.9%	
	Partially Supporting	238.1	42.2	280.3	38.1%	
	Not Supporting	1.0	20.9	21.9	3.0%	
	Total	583.0	153.1	736.1	100.0%	20.9%
Merrimack (4863.7 Miles)	Fully Supporting	531.8	294.0	825.8	94.2%	
	Partially Supporting	3.5	39.0	42.5	4.8%	
	Not Supporting	0.0	8.5	8.5	1.0%	
	Total	535.3	341.5	876.8	100.0%	18.0%
Piscataqua (999.0 Miles)	Fully Supporting	166.1	35.0	201.1	76.0%	
	Partially Supporting	1.5	17.8	19.3	7.3%	
	Not Supporting	1.0	43.3	44.3	16.7%	
	Total	168.6	96.1	264.7	100.0%	26.5%
Saco/Ossipee (893.4 Miles)	Fully Supporting	511.0	0.0	511.0	98.5%	
	Partially Supporting	0.0	0.0	0.0	0.0%	
	Not Supporting	0.0	8.0	8.0	1.5%	
	Total	511.0	8.0	519.0	100.0%	58.1%
All Basins	Fully Supporting	1814.1	419.0	2233.1	83.4%	
	Partially Supporting	243.1	100.0	343.1	12.8%	
	Not Supporting	6.0	95.2	101.2	3.8%	
	Total	2063.2	614.2	2677.4	100.0%	24.6%

Note: Only surface waters used as public water supplies were assessed for the drinking water use.

Table III-4-4
Individual Use Support Summary For Rivers and Streams
***Excluding* the Effects of Mercury[1]**

Use	Size Assessed (Miles)	Size Fully Supporting (Miles)	Size Fully Supporting but Threatened (Miles)	Size Partially Supporting (Miles)	Size Not Supporting (Miles)	Size Not Attainable (Miles)
Aquatic Life	2714.1	2558.2	NA	134.2	21.7	0.0
Fish Consumption	278.8	0.0	NA	265.4	13.4	0.0
Shellfishing	*	*	*	*	*	*
Swimming	2769.1	2657.2	NA	43.4	68.5	0.0
Secondary Contact	10881.2	10881.2	NA	0.0	0.0	0.0
Drinking Water[2]	245.0	245.0	NA	0.0	0.0	0.0
Agricultural	2696.9	2696.4	NA	0.5	0.0	0.0
Cultural or Ceremonial	*	*	*	*	*	*

[1] This table does not include the effects of the statewide fish consumption advisory due to mercury.

[2] Mileage estimated for the use of "Drinking Water" are for rivers/streams currently used as public water supplies.

[3] Asterisk (*) = category is not applicable.

Dash (-) = category applicable but little to no data is available.

Zero (0) = category is applicable, but size of waters in this category is zero.

The fourth most impacted use, *excluding* the statewide fish consumption advisory due to mercury, is agriculture. This general assessment is based on the available chemical information. It does not specifically address waters in agricultural areas. As shown, all but 0.5 miles are considered suitable for agricultural purposes. The 0.5 impaired miles are located at the former Pease Air Force Base, where the presence of jet fuel has been detected in significant concentrations.

As discussed in the previous chapter, all Class A and B waters must, by law, be suitable for drinking after adequate treatment. This implies that surface waters don't have to be potable prior to treatment; consequently, all surface waters most likely fit this definition. For this report, however, only the surface waters currently used as public water supplies were included in the

Table III-4-5
Swimming and Aquatic Life Use Support by River Basin
***Excluding* the Effects of Mercury**

Basin	Swimming		Aquatic Life	
	Not Fully [1] Supporting		Not Fully [1] Supporting	
	Miles	% of all Assessed Basins	Miles	% of all Assessed Basins
Androscoggin	5.0	4.5%	5.0	3.2%
Coastal	0.0	0.0%	0.0	0.0%
Connecticut	33.9	30.3%	79.3	50.9%
Merrimack	23.1	20.6%	30.2	19.4%
Piscataqua	41.9	37.4%	40.4	25.9%
Saco/Ossipee	8.0	7.1%	1.0	0.6%
Total	111.9	100.0%	155.9	100.0%

[1] Not Fully Supporting equals the sum of Partially Supporting plus Not Supporting.

assessment. River miles shown reflect the approximate mileage of rivers and streams upstream of the public water supply intake up to a maximum of about 25 miles. Based on this and the definitions provided in Part III, Chapter 3, Table III-4-4 shows that all 245 miles of rivers and streams currently used as public water supplies are fully supportive of the drinking water use. A list of the rivers and streams currently used as public water supplies is included in Appendix D.

Table III-4-4, also shows that all rivers and streams are considered to be fully supportive of secondary contact uses. This is a general assessment based on the available chemical/biological data. It does not account for the physical characteristics within watersheds such as the drainage area, channel slope and width. These characteristics influence the quantity, depth and velocity of flow, which can, in turn, preclude certain segments from supporting all secondary contact uses.

4.4 CAUSES OF NONSUPPORT

The various causes of nonsupport and the estimated miles that are affected by each are shown in Table III-4-6. Definitions for major, moderate and minor contributions are provided in Part III, Chapter 3. This table does not account for the statewide fish

advisory due to mercury and does not include causes for waters categorized as fully supporting but threatened as such waters are not currently considered impaired. It should also be noted that the value of 810.2 total miles shown in Table III-4-6 differs from the 444.3 miles of impaired waters shown in Table III-4-2 because Table III-4-6 simply represents the sum of all miles affected by all causes, regardless of where they occur while the values shown in Table III-4-2 shows only the total miles of impaired waters. In other words, a segment that is affected, for example, by two causes, would be counted twice in Table III-4-6, but would only be counted once in Table III-4-2.

Metals: Metals were the leading cause of impairment with or without the statewide fish consumption advisory due to mercury. If the statewide mercury fish advisory is *included*, all 10,881.2 miles of rivers and streams would be listed as impaired due to metals (i.e., primarily mercury). *Excluding* the mercury fish advisory, Table III-4-6 shows that approximately 306.1 miles of rivers and streams are impacted by metals.

Excluding the mercury fish advisory, approximately 81percent (248.1/306.1) of metal impairment is due solely to cadmium found in the tissue of fish taken from the Connecticut River. This is based on a study done in 1989 (DHHS, 1989a) which found that although cadmium levels did not pose a significant risk to human health, the cadmium levels in some fish exceeded literature values recommended for the protection of wildlife. The extent of impairment was estimated to be approximately 265.4 miles which includes the main stem of the Connecticut River from the Lake Francis Dam in Pittsburg downstream to the New Hampshire / Massachusetts border. This is the same river segment which was considered to be impaired by PCBs found in fish tissue as discussed later in this section. A comprehensive fish tissue study is planned to begin in the summer of 2000 to determine if the results of the 1989 study are still valid.

In addition to cadmium, exceedances of the chronic standard for aluminum have been measured in the Connecticut River which are estimated to impact an approximate 17.3 mile segment that extends from the Moore's Reservoir to the McIndoe Reservoir. This value is included in the 265.4 miles of the Connecticut River which were reported to be impacted by metals (most of which is due to cadmium). Additional sampling will be conducted to confirm these results and to determine the source, if necessary.

Of the remaining 40.7 miles of rivers and stream impacted by metals, approximately 4.1 miles are located on the site of the former Pease Air Force Base (PAFB) where work continues to clean up the five brooks that were contaminated years ago from past operations at the base. Former industrial discharges are the suspected source of manganese exceedances in Lower Newfields Brook in Portsmouth (0.5 miles) and of multiple metal exceedances in Lower Grafton (0.5 miles) and Pickering Brook (1.1 miles) in Portsmouth and Newington respectively. An old landfill at the former PAFB is the suspected source of numerous metal exceedances in Peverly Brook (1.0 mile) in Newington, and airport runoff is the suspected source of manganese exceedances in McIntyre Brook (1.0 mile) in Newington and Portsmouth.

Table III-4-6
Rivers and Streams Not Fully Supporting Uses By Various Cause Categories
Excluding the Effects of Mercury

Cause Category	Size of Waters by Contribution to Impairment			
	Major (Miles)	Moderate/Minor (Miles)	Total (Miles)	Percent (Miles)
Cause unknown	0.0	0.0	0.0	0.0
Unknown toxicity	0.0	0.0	0.0	0.0
Pesticides	0.0	0.0	0.0	0.0
Priority organics	0.5	0.0	0.5	0.1
Nonpriority organics	0.0	0.0	0.0	0.0
PCBs [(1)]	0.0	265.4	265.4	32.8
Dioxins	12.5	1.0	13.5	1.7
Metals	0.0	306.1	306.1	37.8
Ammonia	0.0	0.0	0.0	0.0
Cyanide	0.0	0.0	0.0	0.0
Sulfates	0.0	0.0	0.0	0.0
Chlorine	0.0	0.0	0.0	0.0
Other inorganics	0.0	0.0	0.0	0.0
Nutrients	0.0	6.0	6.0	0.7
pH	1.0	0.0	1.0	0.1
Siltation	0.0	56.0	56.0	6.9
Organic enrichment/low DO	19.2	18.5	37.7	4.7
Salinity/TDS/chlorides	0.0	0.0	0.0	0.0
Thermal modifications	0.0	0.0	0.0	0.0
Flow alterations	0.0	5.1	5.1	0.6
Other habitat alterations	0.5	10.6	11.1	1.4
Pathogen indicators	68.5	39.4	107.9	13.3
Radiation	0.0	0.0	0.0	0.0
Oil and grease	0.0	0.0	0.0	0.0
Taste and odor	0.0	0.0	0.0	0.0
Suspended solids	0.0	0.0	0.0	0.0
Noxious aquatic plants (macrophytes)	0.0	0.0	0.0	0.0
Excessive Algal Growth	0.0	0.0	0.0	0.0
Total toxics	0.0	0.0	0.0	0.0
Turbidity	0.0	0.0	0.0	0.0
Exotic species	0.0	0.0	0.0	0.0
Other (specify)	0.0	0.0	0.0	0.0
Total	102.2	708.0	810.2	100.0

Approximately 3.4 miles are due to iron from landfills on Beaver Brook in Derry (1.5 miles), Frazier Brook in Danbury (1.4 miles) and Williams Brook in Northfield (0.5 miles) . The Old Danbury Landfill on Frazier Brook and the Northfield Stump Dump adjacent to Williams Brook have been closed and capped and the Derry Landfill on Beaver Brook is in the process of being closed and capped. Over time, iron leaching from the landfills into the streams is expected to decrease. Monitoring of these streams will continue to confirm this.

An industrial point source (GTE) is suspected of being the primary source of various metal exceedances on Pickering Brook (1.0 mile) in Greenland. Other possible sources include the Novel Iron Works Company and/or a truck stop (Travelport) located upstream which was connected to an old septic system. The Novel Iron Works Company was issued an Administrative Order by EPA in 1997 for failure to implement a stormwater pollution prevention plan. In October of 1997, the plan was submitted and is presumably being implemented. In 1999, the truck stop was connected to Portsmouth's sewer system which enabled them to abandon their old septic system. Follow up sampling will be conducted to determine if water quality standards are now being met.

Illicit sewer connections to a storm drain are the suspected source of copper and zinc exceedances on Moonlight Brook (0.3 miles) in Newmarket. In 1999, the Town identified and eliminated 2 sewer pipes that were directly connected to the storm drain and replaced two sewer laterals that were exfiltrating sewage to the storm drain. Confirmation sampling will be conducted to determine if water quality standards are now being achieved.

In Exeter, urban or highway runoff is the suspected source of wet weather exceedances of copper in the Exeter River (1.5 miles) and of copper, aluminum and zinc in Wheelwright Creek (0.5 miles). Additional investigations are needed to confirm the exceedances and the source.

The source of the remaining 29.9 miles of metal exceedances in rivers and streams, is listed as unknown. Specifics for these waterbodies can be obtained from the list provided in Appendix C. Further investigations will be conducted to determine if exceedances still exist and/or the likely source, many of which are suspected to be of natural origin.

Although numerous metal exceedances have been measured, it is important to realize that the actual impact that these metals have on the aquatic life is questionable. This is for three reasons, the first of which is because "clean" sampling techniques were not used in most, if not all cases to sample and analyze for metals. Studies have shown that the metal concentrations in clean technique samples can be significantly lower than in samples taken employing standard methods. Consequently, if clean techniques had been employed, it is believed the number of exceedances would go down. The reason why clean techniques are not often practiced is because the equipment is relatively expensive, there are very few laboratories which can analyze samples using clean techniques and it is quite time consuming to take samples this way.

The second reason why impairment based on metal exceedances may give a false impression of the impact on aquatic life, is because many of the metal concentrations are based on the total metal, and not the dissolved fraction, which is believed to be the more toxic form (see Part III, Chapter 3). In many cases, the dissolved fraction is significantly lower than the total metal concentration. Consequently, if dissolved metal concentrations had been sampled, analyzed and compared against the dissolved metal water quality standards, it is believed that the number of exceedances would be reduced.

The third reason relates to the amount of time an organism is exposed to the metal. The acute water quality standards for metals are based on one hour of exposure versus four days of exposure for development of the chronic water quality standards. Most of the metal samples used in this assessment, however, are grab samples which represent only an instant in time. In addition some of the metal exceedances occurred only during wet weather which are relatively short term and highly variable events. Because of the variable nature of rivers and streams, especially during storm events, which can affect how long an organism is exposed to a particular metal concentration, some of the miles reported to be impaired because of metals, may not actually have aquatic life impairment.

The issues raised above regarding the use of metals to determine aquatic life impairment emphasizes the need to continue biomonitoring efforts in the State. Bioassessments are an important part of aquatic life assessments because they can provide valuable information as to whether or not the resident aquatic organisms are actually being impaired by the integrated effects of different pollutant stressors, such as metals, over various periods of time.

PCBs: Polychlorinated biphenyls (PCBs) are the second leading cause of impairment, excluding the effects of the statewide fish consumption advisory due to mercury. As shown in Table II-4-6, PCBs in fish tissue are estimated to impact 265.4 miles, all of which are on the Connecticut River. As discussed earlier in this chapter and in Part III, Chapter 8, this is based on a study done in 1989 which found PCBs in the tissue of fish taken from the Connecticut River. Because PCB levels were below the FDA tolerance level of 2 ppm and similar to levels found in fish tissue taken from other rivers in the Northeast, a restricted consumption advisory was not warranted. However, since PCBs were detected, it was decided to issue an informational health advisory instead which advises people how to prepare the fish to further limit the potential for PCB consumption.

The source of PCBs is listed as unknown since the exact source is not known. It is suspected, however that the PCBs are from discharges that occurred in the past since the production of PCBs was banned in the United States in the 1970s. This combined with the fact that PCBs are very persistent in the environment and can bioaccumulate in the food chain, is why historical discharges are suspected.

As previously mentioned, a fish tissue study of the Connecticut River is planned to begin in the summer of 2000. The results of this study should help to determine if the

findings of the 1989 study are still valid and if the existing informational health advisory on the Connecticut River should be rescinded, left the same or upgraded.

Pathogens (bacteria): *Excluding* the statewide fish consumption advisory, Table III-4-6 shows that pathogen indicators (i.e., bacteria) are the third leading cause of impairment. As discussed in the previous section, bacteria was used to assess the use of swimming or primary contact recreation. Bacteria exceedances are estimated to exist in 107.9 miles (13.3 percent) of the 846.5 total miles of rivers and streams that are impacted by all causes.

Approximately 24.1 miles of freshwater rivers are impaired by bacteria from combined sewer overflows (CSOs). As discussed in Part III, Chapter 3, bacteria from CSOs are defined as having a partial impact on swimming because they only occur when it rains or during periods of snowmelt when primary contact uses such as swimming generally do not occur. Freshwater rivers impaired by bacteria from CSOs exist on the Androscoggin River in Berlin (1.0 mile), along the Merrimack (7.5 miles) and Piscataquog (1.5 miles) Rivers in Manchester, on the Nashua (3.1 miles) and Merrimack (4.5 miles) Rivers in Nashua and along Great Brook (0.5 miles) and the Mascoma (4.0 miles) and Connecticut (2.0 miles) Rivers in Lebanon. As discussed in Part II, Chapter 2, work is underway to abate pollution from CSOs in each of these communities. CSOs also exist in Exeter and Portsmouth, however these systems discharge to tidal waters and therefore are addressed in Part III, Chapter 6.

Farm animals (manure) are the suspected source of bacteria in approximately 15 miles of river and streams. These include Blodgett Brook (1.0 mile) and Hardy Hill Brook (1.0 mile) in Lebanon, Clay Brook (1.0 mile) in Charlestown, Halls Stream (2.0 miles) in Pittsburg, Morris Brook (1.5 miles) in Haverhill, Dudley Brook (1.0 mile) in Raymond, three unnamed tributaries (1.5 miles) to the Squamscott River in Stratham, Great Brook (4.0 miles) in East Kingston, and the Connecticut River (2.0 miles) in Lancaster. Where the source is farm animals, the New Hampshire Department of Agriculture is called upon to work with the farmer to take corrective action.

Natural sources (i.e., wildlife) were attributed to bacteria exceedances found in 8.0 miles of rivers and streams. Affected rivers and streams include the Bellamy River (1.0 mile) in Dover, Mink Brook in Hanover (1.0 mile), Minnewawa Brook (1.0 mile) in Keene, Mirey Brook (1.0 mile) in Winchester, and the South Branch Ashuelot River in Marlborough (2.0 miles) and Troy (2.0 miles). As discussed in Part III, Chapter 3, bacteria exceedances due to natural sources are not considered violations of State surface water quality laws. Consequently, no regulatory action is planned at this time to abate these occasional exceedances.

Discharges of untreated wastewater due to cross connections between the sewer system and the stormdrain pipes are the suspected cause of bacteria exceedances in approximately 7.8 miles of rivers and streams. Approximately 5.0 miles are located in Berlin along the Androscoggin (4.0 miles) and Dead rivers (1.0 mile). One of the four miles impacted on the Androscoggin River is also impacted by a CSO in Berlin which

they intend to eliminate by removing excessive inflow/infiltration in the collection system. Since 1991 the City has done extensive smoke testing of their sewer system to identify the location of illicit connections to the stormdrains. As a result the City found and eliminated approximately 300 cross connections. It is believed that all cross connections have been corrected. Additional testing will be conducted to confirm this. Another 2.8 miles of rivers / streams that are, or are suspected of being impacted by bacteria from cross connections, exist on Willow Brook in Rochester (0.5 miles), Moonlight Brook in Newmarket (0.3 miles), and the Cocheco River (1.0 mile) and Cricket Brook (1.0 mile) in Dover. As previously mentioned, the Town of Newmarket eliminated two direct connections and repaired two sewer laterals that were exfiltrating sewage to the storm drains in 1999. On Willow Brook, sewers from two houses have been found to be connected to the storm drain. The Town expects to eliminate these connections in 2000. Further investigations are needed at the other waterbodies to confirm the source of bacteria.

Urban runoff from roadways is the suspected source of wet weather bacteria exceedances measured in the Exeter River (1.5 miles) in Exeter. Additional investigation is needed to determine the actual source which will dictate the next course of action.

In the remaining 51.5 miles of rivers and streams that are potentially impacted by bacteria, the source of bacteria is unknown. Details regarding the location of these waterbodies may be found in Appendix C. Additional investigations will be conducted to determine if exceedances still exist, and if so, what must be done to bring the waterbody into compliance with water quality standards. In many cases, investigations have revealed that many bacteria exceedances, especially those that occur during wet weather, are due to natural sources such as wildlife.

Siltation/Erosion: Siltation/erosion was the fourth leading cause of impairment excluding the statewide mercury fish advisory. Erosion and subsequent siltation can negatively impact aquatic life habitat. Of the 56.0 miles estimated to be impacted by erosion, 55.0 miles are on the Connecticut River and approximately one mile is along the banks of the Ashuelot River in Keene. Based on information provided by the U.S. Fish and Wildlife Service, erosion along the Ashuelot River is believed to be due to a golf course in Keene.

The Connecticut River Forum, which consists of numerous representatives from local, state and federal levels, has recognized erosion on the Connecticut River as significant cause of habitat degradation (CRF, 1998). Estimates of river miles affected by erosion along the Connecticut River are based on erosion inventories conducted by the Grafton and Coos County Conservation Districts in 1992 and 1995 respectively (GCCD et al., 1993, and CCCD et al., 1995). Of the total miles impacted by erosion along the Connecticut River, approximately 79 percent (43.5 miles) are believed to be primarily due to agricultural practices and the remaining 21 percent (11.5 miles) are thought to be primarily due to development along the river banks. Flow fluctuations due to hydropower operations and/or boat wakes may also contribute to erosion.

It is envisioned that local Conservation Districts and watershed organizations will play a significant role in efforts to stabilize existing river banks and to encourage land management practices which minimize erosion and sedimentation from various development and agricultural practices. The rate at which these objectives will be achieved, however, is contingent upon the availability of funding.

Low Dissolved Oxygen: Low dissolved oxygen (DO) is the fifth highest cause of impairment *excluding* the statewide mercury fish advisory, and was used to assess aquatic life support. As shown, approximately 37.7 miles or 4.7 percent of the total impaired miles was due to low DO.

Point source discharges are estimated to cause low DO in approximately 6.7 miles of rivers and streams. On the Contoocook River, low DO accounts for 2.0 miles of impairment due to the Peterborough WWTF (1.0 mile) and the Monadnock Paper Company WWTF (1.0 mile). Results of a draft Total Maximum Daily Load (TMDL) study indicates that advanced treatment is needed at both facilities, and possibly at the Antrim WWTF. This study is scheduled to be completed in 2000.

On the Cocheco River, 1.2 miles of low DO is due to the Rochester WWWT. In accordance with their Administrative Order, the City is in the process of constructing an advanced WWTF which will be operational in the year 2000.

Approximately 1.0 mile along the upper portion of the Sugar River Sunapee is shown as being impaired for DO due to the Sunapee WWTF. Though no DO violations have been measured, this is included because preliminary modeling suggests that when the Sunapee WWTF is at full permitted design flow, DO violations could possibly occur. Additional sampling and modeling will be conducted to determine appropriate effluent limits for the WWTF.

The last point source discharge is the Epping WWTF, which is main source of source of approximately 2.5 miles of low DO on the Lamprey River. A TMDL has been conducted on the Lamprey River which shows that advanced treatment is necessary at the Epping WWTF. In the winter of 2000, the NPDES permit for Epping was reissued with advanced limits. Construction of an upgraded plant is expected to begin in 2001.

Dams (hydromodifications) are estimated to be the primary source of low DO in approximately 6.0 miles of rivers and streams. This includes approximately 5.0 miles along Connecticut River in the vicinity of the Moores, McIndoe and Comerford Dams, 1.0 mile on the Cocheco River in Rochester. A study is currently being done by the owner of the Moores, McIndoe and Comerford Dams to determine how these exceedances can be remedied. Further investigations will be conducted on the Cocheco River to verify the exceedances and identify the next course of action.

The Farmington and Cardinal landfills in Farmington are the suspected source of low DO along approximately 3.0 miles of the Cocheco River in Farmington. Both landfills are in the process of being capped and closed.

Low DO has also been measured in Hardy Brook (0.5 miles) in Lebanon. This is believed to be due to organic loadings from agricultural activities in the area.

The remaining 21.5 miles of low DO are attributable to unknown sources. Specifics regarding the location of these waterbodies may be found in Appendix C. Additional investigations will be conducted on these waterbodies to identify the sources, some of which may be natural.

Dioxin: The sixth highest cause of impairment *excluding* the statewide mercury fish advisory is dioxin which accounts for approximately 13.5 miles or 1.7 percent of the total miles impaired by all causes. As discussed in Part III, Chapter 8, all 13.5 miles are located along the Androscoggin River below Berlin, where a fish advisory has been in effect since 1989 due to dioxin from the Crown Vantage Company Paper Mills in Berlin. The source of dioxin has been eliminated through process changes at the mill, however dioxin levels in fish tissue are still not low enough to rescind the fish consumption advisory. More fish tissue sampling is planned in the future.

Habitat Alterations: Habitat alterations are estimated to impact aquatic life in approximately 11.1 miles of rivers and streams and are the seventh highest cause of impairment. The source of impairment in approximately 4.0 miles is suspected of being due primarily to urban or highway runoff with 1.0 miles located on the Piscataguog River in Manchester, 1.0 miles located on the Souhegan River in Greenville and 2.0 miles along the Oyster River in Durham. On the Cocheco River (1.2 miles) the source of impairment is believed to be the Rochester WWTF which is in the process of being upgraded. The source of impairment is unknown in the remaining 5.9 miles. This includes 1.0 mile on the South Branch of the Piscataquog River in Goffstown, 1.0 mile on the Squam River in Ashland, 1.5 miles located on the Ashuelot River in Winchester and 2.4 miles along the Cocheco River in Farmington. Additional investigations will be conducted to determine the next course of action.

Nutrients (Phosphorus): The nutrient phosphorus is the eighth leading cause of impairment in approximately 6.0 miles of rivers and streams. High concentrations of nutrients can lead to excessive algal blooms and macrophyte growth which can impair swimming and, in some cases, contribute to low DO which can impact aquatic life. Algal blooms have been observed along approximately 5.0 miles of the Lamprey River and along approximately 1.0 mile of the Salmon Falls River upstream of the Rollinsford Dam. Results of a TMDL conducted on the Lamprey River (NHDES, 1995b), indicate that the Epping WWTF is one of the primary sources of phosphorus loadings to the Lamprey River. As previously mentioned, the NPDES permit for Epping was recently reissued with phosphorus limits. On the Salmon Falls River, a joint TMDL between the States of Maine and New Hampshire, was completed in 1999. As a result of this TMDL, NPDES permits for the Somersworth, Rollinsford and Milton WWTFs are in the process of being reissued with phosphorus limits.

Flow Alterations: The ninth leading cause of impairment is flow alterations due to the construction and operation of dams. Excessive periods of low flow in a river or

stream can adversely impact aquatic life. Based on information provided by the U.S. Fish and Wildlife Service (USFWS), low flow is a concern in the bypass reaches of dams located on Connecticut River (0.2 miles in Pittsburg and 0.2 miles in North Walpole), the Sugar River (0.1 mile in Claremont), the Contoocook River (0.1 mile in Hillsboro and 0.8 miles in Boscawen and Penacook), the Mad River in Campton (0.1 miles), the Merrimack River in Bow (0.1 mile), Hooksett (0.1 mile), and Manchester (0.3 miles), the Piscataquog River in Goffstown (2.7 miles) and the Suncook River in Suncook (0.4 miles). Investigations will be conducted and dam licenses will be reviewed to determine what is necessary to obtain sufficient flows in these reaches.

pH and Priority Organics: The last two causes of impairment are pH and priority organics. Low pH in the Souhegan River due to the discharge from an industrial point source (Pilgrim Foods) accounts for 1.0 mile of impairment and fuel oil (priority organics) from past activity at the former Pease Air Force Base is responsible for the contamination of approximately 0.5 miles of Pauls Brook. Efforts continue at Pilgrim Foods to resolve pH exceedances. The major source (a direct pipe to the river) was eliminated in 1998. The facility is currently working on a Stormwater Management Plan which should address remaining sources of on-site acidic material which could impact pH levels in the river. At the former Pease Air Force base, a remediation plan to clean up the fuel oil was completed in 1997. Results of follow-up monitoring conducted by the U.S. Air Force needs to be reviewed to determine if levels are now attaining water quality standards.

4.5 SOURCES OF NONSUPPORT

A summary of the probable sources of pollutants causing nonsupport, *excluding* the effects of the statewide fish consumption advisory due to mercury, is presented in Table III-4-7. Major, moderate and minor contributions to impairment are defined in Part III, Chapter 3. For reasons similar to those presented in Section 4.4, the figure of 810.2 total miles shown in Table III-4-7 does not equal the 444.3 miles of impaired rivers shown on Table III-4-2. This is because the value of 810.2 represents the sum of all miles affected by all sources, regardless of where they occur. Because it double counts areas that are affected by multiple sources, the total miles shown in Table III-4-7 is greater than the total miles of impaired waters reported in Table III-4-2.

As previously mentioned, a listing of all impaired rivers and streams including the river name, location, and the miles, cause and source of nonsupport, as well as a description of activities which are underway or planned to resolve the water quality exceedances, is provided in Appendix C. The location and cause associated with each source of impairment is also provided in the previous section (4.4).

As shown in Table III-4-7, the majority of sources of impairment are unknown (79.3 percent which represents 642.2 miles). Most of this, however, is due to Connecticut River fish advisory where the sources of the PCBs and cadmium found in fish tissue were listed as unknown. The sources of these two pollutants account for approximately 530.8 miles (265.4 + 265.4) or 82.7 percent of the total miles reported as

Table III-4-7
Rivers and Streams not Fully Supporting Uses Affected by Various Source Categories *Excluding* the Effects of Mercury[1]

Source Category	Contribution to Impairment			
	Major (Miles)	Moderate/Minor (Miles)	Total (Miles)	Percent (%)
Industrial Point Sources	14.0	5.1	19.1	2.4
Municipal Point Sources	2.2	9.7	11.9	1.5
Combined Sewer Overflows	0.0	24.1	24.1	3.0
Collection System Failure	0.0	0.0	0.0	0.0
Domestic Wastewater Lagoon	0.0	0.0	0.0	0.0
Agriculture	13.5	45.5	59.0	7.3
Crop-related sources	0.0	43.5	43.5	5.4
Grazing -related sources	7.0	2.0	9.0	1.1
Intensive Animal Feeding Operations	6.5	0.0	6.5	0.8
Silviculture	0.0	0.0	0.0	0.0
Construction	0.0	0.0	0.0	0.0
Urban Runoff/Storm Sewers (including Illicit Sewer Connections)	7.8	5.6	13.4	1.7
Resource Extraction	0.0	0.0	0.0	0.0
Land Disposal (Landfills)	3.0	4.4	7.4	0.9
Hydromodification	3.0	8.1	11.1	1.4
Habitat Modification (non-hydromodification)	0.0	11.5	11.5	1.4
Marinas and Recreational Boating	0.0	0.0	0.0	0.0
Erosion from Derelict Land	0.0	0.0	0.0	0.0
Atmospheric Deposition	0.0	0.0	0.0	0.0
Waste Storage/Storage Tank Leaks	0.0	0.0	0.0	0.0
Leaking Underground Storage Tanks	0.0	0.0	0.0	0.0
Highway Maintenance and Runoff	0.0	1.5	1.5	0.2
Spills (Accidental)	0.0	0.0	0.0	0.0
Contaminated Sediments	0.0	0.0	0.0	0.0
Debris and Bottom Deposits	0.0	0.0	0.0	0.0
Internal Nutrient Cycling (primarily lakes)	0.0	0.0	0.0	0.0
Sediment Resuspension	0.0	0.0	0.0	0.0
Natural Sources[2]	1.0	7.0	8.0	1.0
Recreational and Tourism Activities	0.0	1.0	1.0	0.1
Salt Storage Sites	0.0	0.0	0.0	0.0
Groundwater Loadings	0.0	0.0	0.0	0.0
Groundwater Withdrawal	0.0	0.0	0.0	0.0
Other (Specify)	0.0	0.0	0.0	0.0
Unknown Source	57.7	584.5	642.2	79.3
Sources Outside State Jurisdiction/borders	0.0	0.0	0.0	0.0
Total	102.2	708.0	810.2	100.0

(see notes on next page)

Notes to Table III-4-7

[1] This table does not include the sources for "fully supporting but threatened" waters as these waters are not currently impaired.

[2] State law allows water quality exceedances due to natural sources; consequently no waters are reported as being impaired for this category.

[3] Asterisk (*) = category not applicable.
Dash (-) = category applicable, no data available.
Zero (0) = category applicable, but size of waters in the category is zero.

impaired by unknown sources. The second leading source of impairment is agriculture which impacts an estimated 59 miles. This is followed by CSOs (24.1 miles), industrial point sources (19.1 miles), urban runoff/storm sewers (including illicit sewer connections) (13.4 miles), municipal point sources (11.9 miles), habitat modifications (11.5 miles), hydromodifications (11.1 miles), natural sources (8.0 miles), landfills (7.4 miles), highway maintenance / runoff (1.5 miles), and recreational / tourism activities (golf course) (1.0 mile).

In all, it is estimated that nonpoint sources account for approximately 91.5 percent (741.7 miles) and point sources approximately 8.5 percent (68.5 miles) of the total miles of impaired rivers and streams. Point sources include industrial and municipal point sources, cross connections between the sanitary sewer pipe and stormdrain systems, and CSOs. Agricultural, urban runoff, land disposal, hydromodification, habitat modification, highway/maintenance runoff, natural, recreational and tourism activities (golf course), and unknown sources were considered nonpoint sources. It should be noted however, that the assumption that all unknown sources are nonpoint heavily skews the results. As previously mentioned, approximately 79.3 percent of the total miles impaired by all sources are unknown and approximately 82.7 percent of unknown sources (530.8 / 642.2) are attributable to the PCBs and cadmium found in the tissue of fish taken from the Connecticut River.

PART III, CHAPTER 5

WATER QUALITY ASSESSMENT OF LAKES

5.1 WATER QUALITY SUMMARY STATISTICS

The presentation and discussion of summary statistics for use support and for causes and sources of impairment to lakes may be found in the Section 5.2.5, “Impaired and Threatened Lakes”.

5.2 CLEAN LAKES PROGRAM REPORT (SECTION 314)

5.2.1 Background

Introduction

This chapter constitutes New Hampshire's Lake Water Quality Assessment Report as required by Section 314 (a)(2) of the Clean Water Act, as amended in 1987. All the requirements outlined in Section 314 (a)(1)(A)-(F) can be found in this Chapter. In addition, the lake related requirements of the 305(b) report, including the lakes monitoring program of Part III, Chapter 1, the comprehensive assessment plan of Part III, Chapter 2, the lake assessment methodology of Part III, Chapter 3, and the lake toxics information of Part III, Chapter 8 have been incorporated into this Chapter.

Significant Lake

New Hampshire's definition of a significant lake, for the purposes of the Section 314 Clean Lakes Program, is as follows:

A "significant lake" is any freshwater lake or pond that has a surface area of 10 or more acres, is not private, and does not prohibit recreational activity. It includes both natural and manmade lakes. Significant lakes do not include saltwater ponds, public water supplies (unless recreational activities are not prohibited), wetlands, or river impoundments (unless the impoundment functions as a lake both hydrologically and recreationally). A lake does not need an unencumbered public access to be considered significant. However, a lake completely surrounded by private land under one ownership, and where access is not granted to the general public, is considered to be private for the purposes of Section 314 of the Clean Water Act. This includes natural ponds that are legally "public waters". In addition, trout ponds less than 10 acres that are stocked by the N.H. Fish and Game Department and are open to the general public for fishing are considered to be significant lakes. This definition for significant lake is unchanged from past 305(b) reports.

Please recall that the Clean Lakes Program is directed toward accessible recreational lakes. While public water supplies and wetlands are not considered significant under the Clean Lakes program, clearly they are significant under other DES programs.

Number of Lakes

The exact number of lakes is difficult to determine. Different groups have different definitions of lakes depending on their area of responsibility. When is an impoundment a lake and when is it a river reach? What distinguishes an open-water marsh (a wetland) from a weedy pond (a lake)?

The EPA's draft Total Waters Report lists all waterbodies shown on the U.S. Geological Survey's 1:100,000 hydrologic maps. It does not include run-of-river impoundments or wetlands. This report lists a total of 1708 lakes and ponds of all size for New Hampshire, comprising a total area of 163,033 acres. Using the same database, the number and total area of lakes greater than or equal to 10 acres is 990 and 159,052 acres respectively.

DES' publication *Official List of Public Waters in New Hampshire* (revised, 1994) lists 975 waterbodies of 10 acres or more. However, this listing includes run-of-river impoundments.

DES' Clean Lakes database lists 1077 different waterbodies, 148 of which are not considered to be freshwater lakes because they are salt ponds (3) or wetlands (48), or are not lakes because they are run-of-river impoundments, breached dams, or wide areas in a river (97). Of the remaining 929 lakes, 85 are not significant because they are private (47), water supplies (33), or are less than 10 acres and not stocked by Fish and Game (5). Data is available for some of the non-significant lakes and this data is reported in the use support assessments in Section 5.2.5 (tables 5-5 through 5-10). Note: Data is also available for some of the waterbodies designated as wetlands; this data was reported in previous 305(b) reports under lakes but is not reported in this report for lakes. A total of 146 lakes have not been inventoried for significance. At this time New Hampshire has 698 known significant lakes: 683 have been surveyed for trophic data, 14 were sampled for acid rain parameters and one was visited but was inaccessible for sampling. The number of lakes and total acreage in the various categories are shown in Table III-5-1.

Table III-5-1
Number and Acreage of Lakes in Various Categories

Category	Number	Percent	Acreage	Percent
Significant Lakes	698	75	156,212	93
Non-significant Lakes	85	9	7,602	4.5
Non-inventoried Lakes	146	16	4,203	2.5
Total Lakes	**929**	**100**	**168,017**	**100**

The non-inventoried lakes are lakes for which DES has no recent information. Most of these lakes are small (in total they represent only 2.5 percent of the total lake surface area), and many appear to be inaccessible according to topographic maps. Determining the significance of these lakes, and surveying those that are significant, has been and continues to be one of the goals of the state's lake water quality assessment programs.

It is interesting to note that the total acreage of the 929 lakes listed above (168,017 acres) is greater than the total acreage of the 1708 lakes listed in the atlas (163,033 acres) from EPA's total waters report.

5.2.2 Trophic Status

Trophic Classification System

The system used to trophically classify lakes and ponds in New Hampshire is presented in Table III-5-2. The system consists of four criteria that measure the biological production that occurs in a lake as a result of both nutrient inputs and lake aging (filling in). This approach was selected because these are the parameters that are visible to lake users, unlike a system based on nutrient (phosphorus) concentration only. It results in a trophic classification based on in-lake biological production.

Trophic Status of New Hampshire Lakes

Trophic surveys were conducted and trophic classifications assigned to 683 of the 698 significant lakes. The remaining 15 lakes include 14 remote trout ponds which were sampled by helicopter for acid rain parameters but were not surveyed for trophic parameters, and one lake inaccessible for sampling (Barden Pond, Washington) . The water quality data for the remote ponds was used in the use support discussions, but full trophic surveys were not completed and no trophic class was assigned.

The total number of lakes and lake acreage in each of the trophic categories for significant lakes only are summarized in Table III-5-3.

Table III-5-3
Trophic Status of Significant Lakes

Class	No.	Percent	Area (ac).	Percent
Oligotrophic	200	29	116,191	75
Mesotrophic	329	48	31,688	20
Eutrophic	154	23	8,123	5
Totals	**683**	**100**	**156,002**	**100**

Table III-5-2
Trophic Classification System for New Hampshire Lakes and Ponds

1. Summer Bottom Dissolved Oxygen:	**Trophic Points**
a. D.O. > 4 mg/L	0
b. D.O. = 1 to 4 mg/L & hypolimnion volume ≤ 10% of lake volume	1
c. D.O. = 1 to 4 mg/L & hypolimnion volume > 10% of lake volume	2
d. D.O. < 1 mg/L in < 1/3 hypo. volume & hypo. volume < 10% lake volume	3
e. D.O. < 1 mg/L in ≥ 1/3 hypo. volume & hypo. volume ≤ 10% lake volume	4
f. D.O. < 1 mg/L in < 1/3 hypo. volume & hypo. volume > 10% lake volume	5
g. D.O. < 1 mg/L in ≥ 1/3 hypo. volume & hypo. volume > 10% lake volume	6
2. Summer Secchi Disk Transparency:	**Trophic Points**
a. > 7 m	0
b. > 5 m - 7 m	1
c. > 3 m - 5 m	2
d. > 2 m - 3 m	3
e. > 1 m - 2 m	4
f. > 0.5 m - 1 m	5
g. ≤ 0.5 m	6
3. Aquatic Vascular Plant Abundance:	**Trophic Points**
a. Sparse	0
b. Scattered	1
c. Scattered/Common	2
d. Common	3
e. Common/Abundant	4
f. Abundant	5
g. Very Abundant	6
4. Summer Epilimnetic Chlorophyll-a (mg/M^3):	**Trophic Points**
a. < 4	0
b. 4 - < 8	1
c. 8 - < 12	2
d. 12 - < 18	3
e. 18 - < 24	4
f. 24 - < 32	5
g. ≥ 32	6

	Trophic Points	
Trophic Classification	Stratified	*Unstratified
Oligotrophic	0-5	0-3
Mesotrophic	6-10	4-6
Eutrophic	11-21	7-15

*Lakes without hypolimnions are not evaluated by the bottom dissolved oxygen criterion.

5.2.3 Control Methods

In this section the procedures and methodologies used to protect New Hampshire lakes from pollution are discussed. It is divided into two subsections. The first outlines the various lake monitoring programs employed to determine water quality, and constitutes the lake portion of the surface water monitoring program (Part III, Chapter 1). The second section discusses laws, rules, and regulations designed to control pollution to lakes and ponds.

Lake Monitoring Programs

DES operates a number of lake monitoring programs. These programs are designed for various reasons, but the overall goal is to determine current conditions and trends in lake quality in order to determine if the existing regulatory framework is sufficient to protect lake water quality or, conversely, if new controls are needed, or greater public education and outreach activities need to be implemented or improved.

a. *Lake trophic surveys*: Each year a number of lakes are sampled, winter and summer, for various physical, chemical, and biological parameters. The data provides information on current baseline conditions, long-term trends, and water quality compliance, and is used to classify the lakes according to trophic condition. The surveys also provide information on acid rain impacts and aquatic nuisance and exotic weed distributions. Lakes are not surveyed on an annual basis; on average, they are surveyed once (winter and summer) every 10 to 20 years. With the elimination of Section 314 Clean Lakes funding, the number of lakes surveyed and the number of parameters measured were reduced from previously years. Currently, 30 to 40 lakes are surveyed each year.

b. *Volunteer monitoring*: Lakes participating in volunteer monitoring programs are sampled each year, and on several dates during the year. Basic trophic data is collected. The University of New Hampshire and the Biology Bureau of DES operate complementary volunteer monitoring programs. The programs provide the same information as the lake surveys above, as well as short-term trend data. They also provide for citizen involvement and public education. Over 130 lakes presently participate in DES' Volunteer Lake Assessment Program (VLAP) and approximately 50 lakes participate in the UNH Lakes Lay Monitoing Program (LLMP). The two programs combined serve approximately 1000 volunteer citizen monitors.

c. *Acid rain-lake outlet monitoring*: Twenty accessible lake outlets are sampled every year, twice a year, at spring and fall overturn, for acid rain related parameters. Both short and long-term trends of the impacts of acid rain on non-remote lakes are documented.

d. *Acid rain-remote pond monitoring*: Each spring the surface waters of a number of inaccessible remote trout ponds are sampled by helicopter in conjunction with the N.H. Fish and Game Department's fish stocking program. A total of 59 different lakes have been sampled since 1981, and a core of approximately 20 are sampled each year. The program provides short and long-term trend data on acid rain impacts to remote ponds.

e. *Public bathing beach monitoring*: Public bathing beaches throughout the State are sampled once or twice a year during the summer recreational season for bacteriological water quality. The data determines compliance with bacterial standards for swimming areas and trends in bacterial levels. Over 160 beaches are tested.

f. *Boat inspections*: Boats with sanitary facilities are inspected to ensure compliance with State law that prohibits boats to be equipped to allow for overboard discharge of wastewater. All new boats, previously uninspected boats and previously inspected boats with new owners are inspected. The number of inspections varies each year depending on the number of boats encountered that need inspections. During the reporting period, 113 inspections were conducted in 1998 and 83 in 1999.

g. *Special lake studies*: Special lake studies are periodically conducted. Historically, intensive diagnostic studies of individual lakes were conducted with partial funding from the Clean Lakes Program (Section 314). With the elimination of federal funding for this program, such studies are now conducted with volunteer assistance on VLAP lakes only as part of the state Clean Lakes program (see para. *I* below).

Special research projects on lakes are also conducted periodically. During the reporting period, a *Paleolimnological Assessment and Development of Operational Bioassessment for New England Lakes* project was conducted jointly with the State of Vermont and was partially supported with federal funds. The purpose of the research was to look at historical water quality through sediment core analysis and to compare historical and current quality in reference (unimpacted) and developed lakes. Lakes cored for the program include Beaver Lake, Derry (urbanized), French Pond, Henniker (agricultural), Hatch Pond, Eaton (historical logging impacts), Willard Pond, Antrim (pristine-south) and Russell Pond, Woodstock (pristine-north). The long-term goal is to develop a biological assessment protocol to evaluate the biological health of a lake.

Another research project conducted during the reporting period was a joint REMAP project with the State of Vermont. The project was designed to assess mercury levels in lake sediments, water, and fish, and to relate mercury levels to lake and watershed characteristics. The goal is to develop a model to predict fish-mercury levels in various types of lakes and/or watersheds. The long-term goal is to be able to refine fish consumption advisories based on lake/watershed types. Water, sediments and fish were analyzed during the reporting period and a companion study measured mercury levels in loons and other piscivorous birds. Future work will look at mercury levels in other lake trophic levels including zooplankton and macroinvertebrates.

h. *Lake sediment monitoring*: Lake sediment cores are periodically collected and analyzed for heavy metal concentrations as well as phosphorus. The program provides information on historical levels of metals in the sediment (i.e., changes with depth of core), and will, when more data is collected, relate metal levels with external factors such as motor boat activity, urban runoff, and acid rain. During the reporting period, collected sediment cores were associated with the "paleo" and "REMAP" projects discussed in *g* above.

I. *State Clean Lakes program*: This program is designed to protect lakes from aquatic nuisances and to restore lakes that have nuisance aquatic growths. The program has a number of components but two major areas of activities: exotic aquatic plants and lake diagnostic studies. On January 1, 1998, new legislation went into effect that increased the funds allocated to the program, allowing for the expansion and updating of various program components. The first component addresses the threat posed by exotic aquatic plants. The education and outreach component was updated to target water recreationalists and aquatic plant retailers. Pamphlets, fact sheets and other distributional materials were developed to educate the target groups about exotic aquatic plants. The Volunteer Weed Watcher Program was enhanced and updated to encourage more volunteers to participate in monitoring plant growth in their waterbodies. Another component of the exotic plant program is the management of new and existing infestations of exotic plants. The program allows DES to fund 100 % of the management costs for new infestations, and up to 80 % of the treatment costs for existing infestations. The new legislation also allows for the designation of Restricted Use Areas on waterbodies with exotic plant infestations. These areas restrict access to boaters and other water recreationalists to prevent fragmentation of the plants and subsequent dispersal of these mobile plants pieces to other parts of the waterbody. The other major component of the Clean Lakes program is the management of non-exotic water quality problems such as algal blooms, nuisance native plant growth and declining clarity. This program consists of conducting in-depth diagnostic studies of lakes and ponds in the VLAP program, with assistance from volunteers, to determine the causes of water quality declines and to make recommendations about implementation projects that could be used to rehabilitate the waterbody.

Regulations and Enforcement

The State has numerous laws, rules, and regulations designed to protect lakes. The laws are based on the philosophy that it is easier, cheaper, and more logical to protect lakes from degradation than it is to restore degraded lakes. The New Hampshire Department of Environmental Services (DES) has long had a policy of removing point discharges of sewage and waste from lakes and from tributaries to lakes. Over the past two decades a major effort was made through the Construction Grants program to remove such discharges, and, with few exceptions, New Hampshire lakes are free from point discharges. A general discussion of the Division's point source program can be found in Part II, Chapter 2.

New Hampshire has also adopted surface water quality standards that apply equally to lakes as well as rivers and streams. The standards are discussed in Part II, Chapter 2. New Hampshire does not have, and at this time does not see the need for, specific water quality standards for lakes.

In addition to point source controls and water quality standards, DES has produced a non-point source management plan (which is currently being updated), a toxic control strategy, and a combined sewer overflow strategy. All these efforts will help to further protect New Hampshire's lakes and ponds.

A brief summary of some of the laws and regulations that help protect New Hampshire lakes is presented below.

1. All lakes are classified at least B (RSA 485-A:11), which means they're suitable for fishing, swimming, and other recreational activities (RSA 485-A:8-II), and violations of assigned classifications are not allowed (RSA 485-A:12-II).

2. No discharge is allowed to a lake without a permit (RSA 485-A:13-I).

3. No trash can be dumped in or on the banks of a lake (RSA 485-A:15).

4. Marine toilets can't be discharged into a lake (RSA 487:2).

5. Graywater (sink and shower wastes) from boats cannot be discharged into a lake (RSA 487:3).

6. No new point sources of phosphorus to lakes are allowed, and no new discharges of phosphorus to tributaries of lakes are allowed that would encourage weed or algae growth (WS432.10).

7. Existing high quality lakes shall be maintained at their existing high quality (WS439.02).

8. No automobiles may be washed in or driven into any lake (uncodified regulation - may not be enforceable).

9. Automobiles and other petroleum powered vehicles lost through the ice into a lake must be removed (RSA 485-A:14).

10. No dredge and fill activities are allowed in or around a lake without a permit (RSA 482-A:3; 485-A:17).

11. No construction or transportation of forest products (skidding, etc.) can occur near a lake without a permit (RSA 485-A:17).

12. No earth moving activities are allowed near a lake without a permit (RSA 485-A:17).

13. No subsurface disposal system may be installed near a lake without a permit and certain minimum standards met (RSA 485-A:29).

14. No pesticides can be applied within 25 feet of lakes without a permit (RSA 430:28-48) and the recommendation of DES (Pes 502, 601, 604).

15. Cottages near lakes or tributaries to lakes cannot be converted from seasonal to year-round use unless an application for approval of the sewage disposal system has been submitted and approved (RSA 485-A:38).

16. Cottages near lakes or tributaries to lakes cannot be expanded in size such that the load on the sewage disposal system is increased unless an application for approval of the sewage disposal system is submitted (RSA 485-A:38).

17. No property with a sewage disposal system located within 200 feet of a great pond can be offered for sale until a licensed sewage disposal designer has performed a site assessment to determine if the site meets current standards for sewage disposal systems (RSA 485-A:39).

18. The Lakes Management and Protection Program established a lakes coordinator and lakes management advisory committee to prepare: (1) statewide lake management criteria and (2) guidelines for the development of local lake management and shoreland protection plans (RSA 483-A).

19. The Shoreland Protection Act (RSA 483-B) provides minimum protective standards for activities occurring within 250 feet of lakes and ponds with a surface area of 10 acres or more.

20. No household cleansing products except those used in dishwashers shall be distributed, sold or offered for sale in New Hampshire which contain a phosphorus compound in excess of a trace quantity (RSA 485-A:56).

21. No exotic aquatic weeds shall be offered for sale, distributed, sold, imported, purchased, propagated, transported, or introduced in the state (RSA 487:16a).

22. Permits are also required for the following activities, and permits would not be issued if lake water quality were endangered:

groundwater discharges (RSA 485-A:13)
underground storage tanks (RSA 146-A)
solid waste landfills (RSA 149-M)
sludge pits (RSA 149-M)
hazardous waste sites (RSA 147-A)

With most point sources eliminated, the greatest threats to the continued health of New Hampshire lakes are atmospheric deposition (including both acid rain impacts and mercury), the introduction of non-native aquatic organisms and the overuse of and over-development around the lakes. Stormwater runoff from the developed (urban) areas is probably the greatest threat to the health of New Hampshire lakes. Acid rain and mercury impacts have been and continue to be addressed by state and national (Clean Air Act) legislation. DES participated in the Northeast mercury study (NESCAUM, et al., 1998) and is developing a state strategy to reduce mercury in the waste stream and reduce mercury emissions. DES' program to address non-native exotic weeds was described earlier, and DES, Fish and Game and the University of New Hampshire (UNH) Sea Grant program are working cooperatively to combat the importation of zebra mussels. In addition, new legislation was passed in 1997 to prohibit the sale, transport and introduction of exotic aquatic weeds in the state (see # 21 above). This legislation also provided additional state funds as described earlier to expand the program in 1998.

Of the 108 recommendations included in the “Lakes Management Criteria for New Hampshire State Agencies”, ten recommendations called for legislative action. Since the document was released in 1996, the NH General Court has acted upon five of the ten recommendations. The State, through the interagency Council on Resources and Development (CORD) and legislative action, continues to improve its ability to protect lakes from overuse and from stormwater runoff from developed areas.

5.2.4 Restoration/Rehabilitation Efforts

Procedures and methods to protect lakes by controlling sources of pollution were discussed in the previous section. In this section, activities to ameliorate poor water quality conditions that may occur despite the above regulations controlling pollution are discussed.

Lake restoration efforts usually take one of two basic approaches, or a combination of the two. The first is to attack the cause of the problem, the second is to treat the problem. The first involves reducing the amount of phosphorus or sediment erosion entering a lake, the second involves physically removing or treating the offending algae, plant growth, or sediment from the lake.

Lake restoration techniques have been reviewed periodically in the literature, including EPA's 1990 document "The Lake and Reservoir Restoration Guidance Manual", second edition. Reports such as this include a listing of restoration techniques. In this section , procedures that New Hampshire has carried out to restore lake water quality are discussed.

Source Control

Controlling sources of pollution involves controlling both point and nonpoint sources.

Point Sources:

Point sources of phosphorus to a lake are usually removed or reduced by two basic methods. The most common is to divert the discharge away from the lake. A number of New Hampshire lakes

have been restored or protected by sewage diversion, including Lakes Winnisquam, Kezar, Winnipesaukee, Glen, Kellys Falls and Mascoma. A second method to reduce a point source of phosphorus is to provide tertiary treatment to the discharge. Lakes protected through tertiary treatment include Sunapee and Winnipesaukee (spray irrigation), Pearly Pond (phosphorus precipitation) and Kezar (wetlands uptake). In at least one case (Lake Skatutakee) restoration occurred as a result of the cessation of a discharge (a woolen mill closed).

Nonpoint sources:

The Water Division of DES deals with nonpoint sources of pollution, including phosphorus and erosion. As discussed in the previous section, the State has a number of laws that reduce phosphorus and sediment runoff from logging operations, earth moving activities, dredge and fill operations and subsurface disposal systems. The Department also works closely with local planning agencies, the Natural Resources Conservation Service, Cooperative Extension and others to develop and implement best management practices for nonpoint sources. Public information and education is a large part of this process. A general discussion of the nonpoint program can be found in Part II, Chapter 2.

Problem Treatment

Algae:

Historically the Department has used copper sulfate to control algal blooms caused by cultural sources of phosphorus. As point sources have been eliminated, the need for the chemical control of algae has diminished greatly. The DES Biology Bureau personnel continue to maintain pesticide applicator licenses and continue to have the ability to treat algal blooms if conditions warrant. In recent years most copper sulfate treatments have been related to taste and odor or filter clogging problems associated with public water supplies.

Rooted Aquatic plants:

The State funds a program designed to stop the spread of exotic aquatic plants in the State. The money can be used to eradicate new small infestations of exotic plants, and to make matching grants for the management of existing infestations. Table III-5-5 shows the lakes where exotic plants have been eradicated from or managed. Money is also available for public informational and educational efforts.

Lake drawdown has also been used at a number of lakes for the control of aquatic plants other than exotic weeds.

Section 314 Program

The Department participated in the federal Clean Lakes Program (Section 314) when funds were available. A number of Phase I diagnostic/feasibility studies were conducted using existing State personnel as the 30 percent match. Only one 314-funded Phase II implementation project was

completed. However, locally implemented controls, such as outreach and zoning changes, were implemented for a number of lakes as a result of recommendations presented in the Phase I report. In addition, the nonpoint source (319) program and the 104(b)(3) program have provided funds for a number of watershed implementation projects to protect lakes from runoff impacts. The following Phase I, II, III, 319 and 104(b)(3) projects have been undertaken and/or completed at New Hampshire lakes.

Phase I: Kezar Lake, Sutton
Dorrs Pond, Manchester
Crystal Lake, Manchester
Northwood Lake, Northwood
Silver Lake, Hollis (205 (j))
Baboosic Lake, Amherst (205 (j))
French Pond, Henniker (205 (j))
Keyser Pond, Henniker (205 (j))
Webster Lake, Franklin
Mendums Pond, Barrington
Beaver Lake, Derry
Robinson/Ottarnic Ponds, Hudson
Pawtuckaway Lake, Nottingham
Flints Pond, Hollis
Great Pond, Kingston

State funded lake diagnostic studies:

Lake Wentworth, Wolfeboro
Silver Lake, Harrisville (on-going)
Baboosic Lake, Amherst (on-going)
Pleasant Lake, Deerfield (on-going)
Partridge Lake, Littleton (proposed)

Phase II: Kezar Lake, Sutton: sediment phosphorus inactivation through aluminum salts application and management of an upstream wetlands.

Phase III: Kezar Lake, Sutton: monitoring of the long-term effectiveness of hypolimnetic alum treatment to inactivate sediment phosphorus, and evaluation of long-term impacts of aluminum additions to aquatic biota (on-going).

Table III-5-4
Lakes Where Exotic Plants have been Eradicated or Managed

Lake	Town	Method
Arlington Mill Reservoir	Salem	drawdown
Broad Bay	Ossipee	hand removal, herbicide, bottom barrier
Captain Pond	Salem	hand removal, herbicide
Cheshire Pond	Jaffrey	drawdown
Cobbetts Pond	Windham	herbicide
Contoocook Lake	Jaffrey	herbicide, hand removal, bottom barrier
Crescent Lake	Wolfeboro	herbicide, hand removal, bottom barrier
Forest Pond	Winchester	herbicide
Flints Pond	Hollis	hand removal
Island Pond	Derry	drawdown
Lees Pond	Moultonboro	natural (aquatic insects)
Locke Lake	Barnstead	herbicide
Milville Lake	Salem	drawdown, dredging
Mascoma Lake	Enfield	hand removal
Massabesic, Lake	Manchester	bottom barrier, hand removal
Massasecum Lake	Bradford	herbicide, hand removal, bottom barrier, harvesting, restricted use area
Monomonac, Lake	Rindge	herbicide, bottom barrier, hand removal
Mountain Pond	Brookfield	drawdown
Northwood Lake	Northwood	herbicide, hand removal, drawdown
Opechee Bay	Laconia	dredging, hand removal, bottom barrier
Paugus Bay	Laconia	harvesting
Phillips Pond	Sandown	bottom barrier
Silver Lake	Tilton	hand removal, herbicide
St. Paul's School Pond	Concord	harvesting, hydro raking
Sunapee, Lake	New London	hand removal
Suncook Pond, Lower	Barnstead	bottom barrier, hand removal, herbicide
Sunrise Lake	Middleton	herbicide, bottom barrier
Turkey Pond, Big	Concord	harvesting
Turkey Pond, Little	Concord	harvesting
Waukewan, Lake	Meredith	herbicide, hand removal
Wentworth, Lake	Wolfeboro	bottom barrier, herbicide
Winnipesaukee, Lake (several bays & coves)	Alton	herbicide, bottom barrier, hand removal, harvesting
Winnisquam, Lake	Laconia	hand removal, bottom barrier, herbicide

Sect 319: Winnipesaukee, Lake, Gilford: installation of a boat wash station and runoff controls at a marina.

Crescent Lake, Wolfeboro: installation of stormwater collection and treatment controls at a school and a golf course.

Beaver Lake, Derry: installation of manure storage and handling facilities at a dairy farm and stormwater runoff BMPs in 3 subwatersheds.

Pawtuckaway Lake, Nottingham: installation of manure handling and stormwater runoff devices at a dairy farm.

Great Pond, Kingston: installation of stormwater runoff BMPs in one subwatershed and watershed-wide educational outreach (on-going).

Mill (Mine Falls) Pond, Nashua: cooperative watershed assessment, education and outreach (on-going).

Robinson Pond, Hudson: cooperative watershed assessment, education and outreach (on-going).

104(b)(3): Crystal Lake, Manchester: installation of a StormTreat system to treat stormwater runoff from an urban area, with post-installation monitoring using 319 funds.

Supplemental Environmental Projects (SEP):

Manchester, NH: As part of a long-term combined sewer overflow (CSO) strategy, the City of Manchester will implement a broad environmental program (the SEP) as well as standard CSO mitigation measures. One aspect of the SEP is an Urban Ponds Restoration project which will include cooperative watershed assessments, restoration, education and outreach for the following urban ponds in Manchester: Maxwell Pond; Nutt Pond; Stevens Pond; McQueston Pond; Pine Island Pond; Dorrs Pond; and Crystal Lake (on-going).

Miscellaneous: Granite Lake, Stoddard:

Cooperative subwatershed assessment of Franklin Brook and Townline Brook to assess the water quality impacts of the realignment of NH Route 9 on Granite lake. This is a cooperative effort by NHDES, NHDOT and the Granite Lake Association. BMPs will be evaluated and implemented as appropriate (on-going).

The Department also took advantage of Lake Water Quality Assessment grants to supplement and expand its lake management programs. Most of these funds were directed toward collecting more water quality data, purchasing data processing equipment and developing a data management system to allow for the evaluation and reporting of the data (including 305(b) reports). Additional work products resulting from these grants include a revised trophic classification system, a revised lake priority rating model and updated lake restoration priority lists, numerous lake inventory reports and the development of educational materials including lake reports for the layman and partial funding for lake ecology videos.

The Section 314 Clean Lakes Program was extremely beneficial to the lakes programs of New Hampshire. It helped develop many of the lake monitoring programs that provided information for the lake assessments used in this 305(b) report. Unfortunately, with the elimination of federal funding for the program, the lakes programs have suffered. Phase I, II and III projects are no longer conducted. The number of lakes monitored and the parameters analyzed are reduced from previous levels. The state has provided additional state funds to the lakes programs to help offset this loss. State funds were provided to implement the Shoreland Protection Act, to expand the beach and pool inspection program, and to expand the exotic species control and volunteer lake diagnostic study program. Modified diagnostic studies are conducted through the volunteer program (see discussion of State Clean Lakes program on page III-5-7 and list of state-funded lakes on page III-5-12). Once causes and sources of water quality declines are determined, 319 funds (rather than Phase II 314 funds) are now used for lake watershed implementation projects (examples are listed on the previous page).

5.2.5 Impaired and Threatened Lakes

Introduction

This section provides the use support and causes and sources of nonsupport requirements of the 305(b) report, relative to lakes, combined with the "impaired and threatened lakes" requirement of Section 314(a)(1)(E). To comply with EPA guidance, use support information is provided for all assessed lakes, not just significant lakes.

The methodology for assessing use support is defined in detail below. Definitions for aquatic life and swimming use support are unchanged from the 1998 report. The definitions for *monitored* and *evaluated* waters are changed from previous reports, and are explained below.

In past reports the general EPA guideline of five years was used to separate *monitored* from *evaluated* waters. We did not agree with this guideline, and we pointed out in previous reports that we were confident that much of the evaluated lake data accurately portrayed existing conditions. We recently learned that in at least some of the summary reports that EPA provides to Congress, based on all the 305(b) reports in the country, only monitored data is used. The reason is they do not want to report inaccurate or obsolete data. Clearly the intent is to report on data that is considered to accurately portray existing conditions, and not to delete data based on an arbitrary age. New Hampshire feels strongly that much useful, accurate lake data is being lost when reports are based only on data that is five or less years old, and therefore the reason for the change in the definitions of monitored and evaluated.

In a further defense of the definition changes, DES points out the following:

1. The guidelines apply to both lakes and rivers and clearly river water quality can change much more rapidly than lake quality.

2. Some of the quotes from the guidance supplement (section 1.4) include: (a) the 5 year criteria is a 'general guide'; (b) monitored waters are based on 'ambient monitoring data believed to accurately portray water quality conditions'; (c) 'states may use some flexibility in applying these guidelines'; and (d) 'if older ambient data exist for high-quality waters ... with no known pollutant sources, and if those data are believed to accurately portray water quality conditions, those waters could be considered monitored'.

3. New Hampshire is blessed with an abundance of lake water quality data, including surveys conducted in the late 1930s by Fish and Game, DES trophic surveys since 1975, and DES and UNH volunteer monitoring programs since 1979. As our discussion of lake quality trends at the end of this report demonstrates, lakes change very slowly (over geologic time). Obvious exceptions to this include the introduction of an exotic species, a new discharge of a pollutant (and NH allows no point discharges to lakes) or a major watershed change that results in increased runoff.

DES is confident that this change in definition increases the accuracy of lake quality reporting for New Hampshire.

Definitions

The following definitions are provided to explain the methodology used to develop the information presented in this section.

1. ***Evaluated waters***: waters that have been assessed based on ambient water quality data that may not accurately represent current conditions. It is generally more than ten years old, but may be less if the situation warrants it.

2. ***Monitored waters***: waters that have been assessed based on ambient water quality data that is believed to accurately represent current conditions. The data is always less than ten years old and usually is much more recent.

No data is older than 1976 and all assessments are based on ambient water quality data. There are no presumed assessments and no assessments based on other data such as land-use, predictive modeling or windshield surveys.

3. ***Swimming Use***

Not Support

a. *Bacteria*

There are confirmed violations (other than those due to natural causes or by heavy swimming activity at a designated beach) of the state bacterial standard of 406 *Escherichia coli (E. coli)* per 100 ml. in any one sample or 88 *E. coli* per 100 ml in any one sample at a designated swimming beach.

b. Bathing Area Closure

There are one or more bathing area closures per year of greater than one week's duration, or more than one bathing area closure per year of less than one week's duration.

Partially Support

a. *Bacteria*

The lake is subjected to tributary bacteria levels in excess of state standards during storm events.

b. *Bathing Area Closure*

On average there is no more than one bathing area closure per year of less than one week's duration.

c. *Nuisance Plant growth*

Frequent and persistent algal blooms and/or excessive native macrophyte growth and/or exotic macrophyte growth occur that interfere significantly with swimming and are not attributable to natural sources.

Fully Support but Threatened

The swimming use is fully supported but, based on citizen complaints or knowledge of the existing situation, macrophyte and/or algal growth is or may becoming a nuisance, or is expected to become a nuisance due to activity in the watershed (urban ponds).

Fully Support

a. Bacteria

There are no confirmed violations of the state bacteria standards.

b. Bathing Area Closure

There are no beach closures or restrictions in effect during the reporting period.

c. *Nuisance Plant growth*

There are no algal blooms or macrophyte growth that interfere significantly with swimming other than those attributable to natural sources.

*4. **Aquatic Life Use***

Not Support

a. Dissolved Oxygen (D.O.)

There are one or more confirmed exceedances of the state D.O. standard (i.e., the D.O. is less that 75% saturation in the epilimnetic or upper 25% of depth) which are not attributable to natural causes, and the D.O. is less than 5 mg/L.

b. pH

There are one or more confirmed exceedances of pH where the summer epilimnetic pH was less than or equal to 5.5 or greater than 9.0 and the source is not a natural source (i.e., apparent color was less than 30 cpu).

Partially Support

a. Dissolved Oxygen

There are one or more confirmed D.O. values that are less than 75% saturation but are greater than or equal to 5 mg/L in the epilimnetic or upper 25% of depth water level, and are not attributable to natural causes.

b. pH

There are one or more confirmed exceedances of pH where the summer, epilimnetic pH was 5.6 to 6.0 or 8.1 to 9.0 and the source is not a natural source (color < 30).

Fully Support but Threatened

The aquatic life use is fully supported but the summer, epilimnetic chloride value exceeds 200 mg/L.

Fully Support

a. Dissolved Oxygen

There are no confirmed exceedances of the D.O standards (D.O. is greater than or equal to 75 % saturation and 5 mg/L in the epilimnion or upper 25% of depth) other than those due to natural causes.

b. pH

There are no confirmed epilimnetic pH values less than or equal to 6.0 or greater than 8.0 unless naturally occurring.

5. Fish Consumption Use

Not Support

A "no consumption of fish" advisory is in effect for the general public or a subpopulation for one or more fish species.

Partially Support

A "restricted consumption of fish" advisory is in effect for the general public or a subpopulation for one or more fish species, where restricted consumption is defined as a limit on the number of meals or size of meals consumed per unit time.

Fully Support

No "restricted consumption" or "no consumption" fish advisory is in effect for the general public or subpopulation for any fish species.

6. General definitions of other lake uses are provided below.

Shellfishing: The shellfish use category is not applicable to the freshwater lakes of New Hampshire. Freshwater shellfish are not harvested for public consumption.

Secondary Contact: Based on the Department's extensive knowledge of the water quality of New Hampshire lakes, all lakes in the State are considered to fully support all secondary contact uses.

Drinking Water: Based on information provided by the state's drinking water supply program, all lakes currently being used as a public water supply are considered to fully support the public drinking water use.

Agriculture: Toxics are not routinely monitored in New Hampshire lakes (see Section 5.2.8 for the discussion of toxics in lakes). DES has no data to suggest that any of the State's lakes have materials that would interfere with any agricultural uses. Although few, if any, New Hampshire lakes are used as a source for irrigation water, all lakes are considered to fully support agricultural uses.

7. ***Impaired lake***: a lake that does not fully support one or more designated use (see definitions above).

8. ***Major contribution***: A cause/source makes a major contribution to impairment if it is the only one responsible for *nonsupport* of any designated use, or if it predominates over other causes/sources.

9. ***Moderate contribution***: A cause/source makes a moderate contribution to impairment if it is the only one responsible for *partial support* of any use, predominates over other causes/sources of partial support, or is one of multiple causes/sources of *nonsupport* and significantly contributes to this nonattainment.

10. ***Minor Contribution***: A cause/source makes a minor contribution to impairment if it is one of multiple causes/sources responsible for *nonsupport* or *partial support* and contributes little to this nonattainmant.

Comments on Definitions

1. *Aquatic Life Use - Dissolved Oxygen*

It is not unusual for lakes that thermally stratify during the summer months to undergo a D.O. depletion in the hypolimnetic (bottom) waters. The depletion is caused primarily by bacterial respiration in the decomposition of sedimenting organic matter, particularly at the sediment-water interface. The source of the organic matter is primarily organic inputs from terrestrial or tributary sources, although, in more eutrophic lakes, organic matter produced in the sunlit surface waters can also be a significant source. It is difficult to distinguish between natural and anthropogenic sources of organic matter. For that reason, aquatic life use support relative to D.O. is based on D.O. in the upper waters, *unless bottom water D.O. depletions can be attributed to obvious anthropogenic causes.*

2. *Aquatic Life Use - pH*

a. Although the New Hampshire water quality standard for pH is 6.5 to 8.0 unless naturally occurring, aquatic life (particularly fish) is generally not affected until the pH drops below a pH of 6. For that reason, only pH values of 6.0 or less (or greater than 8.0) are considered to be less than fully supporting, unless naturally occurring. Lakes continue to be listed as impaired if the pH exceeds 8, although it is unlikely that a sporadic pH exceedance has a detrimental effect on fish. It is generally acknowledged that pH values up to 9 are harmless to fish and a variety of studies have shown no adverse

effects at pH up to and exceeding 10.

b. It is difficult to distinguish between natural and anthropogenic causes of acidity. All lakes are subject to acid deposition. However, tea colored lakes tend to be naturally acidic due to organic (humic and fulvic) acids created by the decomposition of plant matter. For the purposes of this 305(b) report, natural acidity is defined as acidity in lakes with an apparent color of greater than or equal to 35 color (chloroplatinate) units. Low pH values in a lake with an apparent color of less than 35 are considered to be caused by anthropogenic sources.

3. Fully Supporting but Threatened

The 'fully supporting but threatened' category was not used in the 1998 305(b) report. It was felt that all lakes were threatened by such sources as atmospheric deposition (acid rain/mercury), exotic species introductions, and stormwater runoff, particularly from developed areas. Programs are in place to minimize the threat from these sources.

For this report, the threatened category was used for the swimming use to flag lakes that had algal/macrophyte problems, based on citizen complaints or staff knowledge, that may become worse in the future and cause impairment. In assessing lakes for aquatic life use, it was noted that chloride levels were significantly elevated in ponds adjacent to salted highways. We have no data to indicate that these chloride levels are impacting biota, but decided to use the threatened category to flag these ponds. Chloride values are less than 2 mg/L in remote ponds; ponds in the threatened category have chloride values in excess of 200 mg/L.

Lake Assessment Tables

The following assessment tables are provided, as required in Section 5.1, relative to lake data. There are a number of additional comments that should be made concerning these tables.

1. First of all, the data used to develop these tables was collected from a number of different programs, as discussed beginning on page III-5-5. The different programs collected different parameters at different time periods. For example, the *acid rain - remote ponds* program collected pH data, which was used to assess aquatic life use, but did not collect bacteria or nuisance plant data. Thus, these ponds were not assessed for swimming use unless other data was available.

2. As discussed previously (Section 5.2.1), New Hampshire has 4,203 lake acres that have not been directly assessed for water quality criteria. These acres are included in the assessments for fish consumption, secondary contact and agricultural uses (Table III-5-7) since all New Hampshire lakes are considered to support these uses.

Table III-5-5
Summary of Fully Supporting, Threatened and Impaired Lakes
***Including* the Effects of Mercury**

Degree of Use Support	Assessment Category		Total Assessed Size (acres)
	Evaluated (acres)	Monitored (acres)	
Size Fully Supporting All *Assessed* Uses	0	0	0
Size Fully Supporting All *Assessed* Uses but Threatened for at Least One Use	0	0	0
Size Impaired for One or More Uses	24,236	136,354	160,590
Total Assessed	**24,236**	**136,354**	**160,590**

Table III-5-6
Summary of Fully Supporting, Threatened and Impaired Lakes
***Excluding* the Effects of Mercury**

Degree of Use Support	Assessment Category		Total Assessed Size (acres)
	Evaluated (acres)	Monitored (acres)	
Size Fully Supporting All *Assessed* Uses	22,723	130,468	153,191
Size Fully Supporting All *Assessed* Uses but Threatened for at Least One Use	0	1123	1123
Size Impaired for One or More Uses	1,513	4,756	6,276
Total Assessed	**24,236**	**136,354**	**160,590**

3. If a lake does not fully support one or more uses, it is listed for each non-supporting use in Table III-5-7, but is listed only once in Tables III-5-5 and III-5-6. It is therefore not possible to sum the areas in the former table to obtain the totals in the latter tables.

Table III-5-7
Individual Use Support Summary for Lakes *Excluding* the Effects of Mercury

Use	Size Assessed (acres)	Size Fully Supporting (acres)	Size Fully Supporting but Threatened (acres)	Size Partially Supporting (acres)	Size Not Supporting (acres)	Size Not Attainable (acres)
Aquatic Life	160,570	155,506	54	3,231	1,779	0
Fish Consumption**	168,002	168,002	0	0	0	0
Shellfishing	*	*	*	*	*	*
Swimming	160,406	158,034	1,085	1,287	0	0
Secondary Contact	168,002	168,002	0	0	0	0
Drinking Water	11,699	11,699	-	0	0	0
Agricultural	168,002	168,002	0	0	0	0
Cultural or Ceremonial	*	*	*	*	*	*

* Not applicable
\- Not assessed
** If the effects of mercury were included, no lake acres would be listed as fully supporting for fish consumption.

4. For reasons discussed in the assessment for rivers and streams (see Part III, Chapter 4), and in accordance with EPA guidance, two overall use support tables are provided. Table III-5-5 shows the overall use support for lakes and ponds in New Hampshire if the effects of the statewide fish consumption advisory due to mercury (see Part III, Chapter 8) are *included* in the assessment. As shown in Table III-5-5 all lakes and ponds are considered impaired (less than fully supporting) when the statewide fish consumption due to mercury is accounted for. This is because, by definition, waters where fish consumption advisories are in effect are considered to be either partially or not supporting of fish consumption uses.

   Table III-5-6 shows the overall use support *excluding* the effects of the statewide fish consumption advisory due to mercury. As shown, over 96 percent of the assessed lakes (154,314 acres) are considered to be fully supported of all uses, with less than 1 percent threatened. Table III-5-6 shows that apart from the statewide fish consumption advisory due to mercury, the vast majority of lakes and ponds in New Hampshire are in very good condition.

5. Table III-5-7 shows the Individual Use Support Summary for lakes and ponds. This table *does not include* the effects of the statewide fish consumption advisory due to mercury. If this advisory had been *included* in the assessment, none of the lakes and ponds would be shown as being fully supportive for fish consumption uses. A list of the lakes that are fully supporting but threatened, partially supporting or not supporting the uses of aquatic life and/or swimming, may be found in Appendix C.

6. The assessment for supporting the swimming use based on bacterial (*E. coli*) contamination includes temporal exceedances of criteria at public beaches due to heavy swim loads. The following information, relative to bathing areas, is provided in Table III-5-8 for the reporting period.

Table III-5-8
Summary of the 1998 and 1999 Public Beach Monitoring Program

Year	# of inspections	# of violations	# posted	# closed
1998	320	25	8	3
1999	316	20	9	4

In most cases, the violations were attributed to heavy swim loads, although heavy spring rains and flooding in 1998 may have been responsible for some high numbers early in the season. All beach closures were of short duration and were re-opened within a few days.

A beach is posted if a second sampling of a beach confirms a previous violation. The sign informs the public that the beach may not be safe for swimming because of high bacterial counts. A beach is closed at the discretion of the owner.

The next two tables provide the causes and sources of impaired waters respectively. In most cases best professional judgements of professional, experienced limnologists provided the information. Some explanatory comments are warranted.

1. Table III-5-9 shows the *causes* of impairment in lakes and ponds, *excluding* the effects of the statewide fish consumption advisory due to mercury. Note: both *nutrients* and *excessive algal growth/chl* are listed as possible causes in the table . In past 305(b) reports, *nutrients* was listed as the cause when the problem was excessive algal growth. In this report, the *excessive algal growth* category is used since it more closely describes the swim use support definition. Clearly nutrients may be the cause of the algal growth.

2. Table III-5-10 shows the *sources* of impairment in lakes and ponds, *excluding* the effects of the statewide fish consumption advisory due to mercury. The source for lakes impaired because of low pH is atmospheric deposition because only lakes with a color < 35 are listed (See discussion on p. III-5-19).

As can be seen from Table III-5-10, only 163 acres (2.5 percent) are impaired because of

point sources, while 6,143 acres (97.5 percent) have nonpoint sources of impairment. The point sources include one industrial discharge (a fish hatchery into 21 acre York Pond, Berlin) and one package plant discharge (Franklin Pierce College wastewater treatment facility into a tributary of 142 acre Pearly Pond).

If the statewide mercury-based fish consumption advisory *was* included in the assessment, all 168,002 acres of lakes and ponds would be shown as being impaired by "atmospheric deposition" of mercury.

3. The "Other (Introductions)" category (Table III-5-10) is the source for all lake acres (800) impaired because of exotic plant infestations.

4. Of the 74 acres of noxious aquatic plants (natives) in Table III-5-9, the source is *dam construction* (55 acres) for two ponds (manmade Pillsbury and New Ponds) and *unknown* for the other 15 acres (Mine Falls Pond). Other ponds in the *unknown* source include Baboosic, Keyser and Sebbins Ponds, all impaired because of *excessive algal growth*.

5.2.6 Water Quality Standards for Lakes

New Hampshire's water quality standards apply equally to lakes as well as rivers and streams, although, as with other states, they were developed primarily for streams where constant mixing occurs. Clearly lakes function differently than streams, primarily because of retention times and thermal stratification. As a result, they are more susceptible to problems from nutrient enrichment. For that reason, New Hampshire has criteria for phosphorus that is specific to lakes (Env-Ws 432.03(a)(10)(d)). This criteria allows no new or increased discharge of phosphorus to lakes. In addition, DES is participating on a regional *nutrient criteria for lakes* committee that will lead to regional guidance and, by 2003, state numerical nutrient criteria for lakes.

Beginning in 1996, the state water quality standards recognized the fact that lakes (and impoundments) will naturally thermally stratify (if deep enough), and may undergo dissolved oxygen depletions in the bottom waters during the stratification period. The standards now reflect this difference, that lentic bottom waters may have naturally lower dissolved oxygen levels than lotic waters.

DES does have lake trophic evaluations for certain parameters in lakes (see Table III-5-11). These evaluations can serve as goals for lake associations working to improve their lakes' quality. The numbers are not standards, however, because it is recognized that all conditions can occur naturally in NH lakes.

Table III-5-9
Total Acres of Lakes Impaired by Various Cause Categories
***Excluding* the Effects of Mercury**

Cause Category	Size of Waters by Contribution to Impairment (Acres)	
	Major	Moderate/Minor
Cause unknown	0	0
Unknown toxicity	0	0
Pesticides	0	0
Priority organics	0	0
Nonpriority organics	0	0
Metals	0	0
Ammonia	0	0
Chlorine	0	0
Other inorganics	0	0
Nutrients	0	0
pH	1,779	3,231
Siltation	0	0
Organic enrichment/low DO	0	0
Salinity/TDS/chlorides	0	0
Thermal modifications	0	0
Flow alterations	0	0
Other habitat alterations	0	0
Pathogen indicators	0	18
Radiation	0	0
Oil and grease	0	0
Taste and odor	0	0
Suspended solids	0	0
Noxious aquatic plants (natives)	0	74
Total toxics	0	0
Turbidity	0	0
Exotic species	0	800
Excessive algal growth/chl	0	425

Table III-5-10
Total Acres of Lakes Impaired by Various Source Categories
***Excluding* the Effects of Mercury**

Source Category	Contribution to Impairment (Acres)	
	Major	Moderate/Minor
Minor industrial Point Sources	21	0
Package Plants	0	142
Combined Sewer Overflows	0	0
Agriculture	0	0
Silviculture	0	0
Construction	0	0
Other urban Runoff	0	34
Resource Extraction	0	0
Land Disposal	0	0
Dam construction	0	55
Habitat Modification	0	0
Marinas	0	0
Atmospheric Deposition	1,743	3,215
Contaminated Sediments	0	0
Unknown Source	15	280
Natural Sources	0	0
Other (Introductions)	0	800
Recreational and Tourism Activities (Heavy Swim Loads)	0	1

Table III-5-11
Trophic Evaluations for New Hampshire Lakes

Parameter	Oligotrophic	Mesotrophic	Eutrophic
Chlorophyll (ug/L)	0-4	4-15	>15
Secchi disk (m)	>4	1.8-4	<1.8
Total phosphorus (mg/L)	<.01	.01-.02	>.02

5.2.7 Acid Effects on Lakes

Introduction

An alkalinity or ANC value of 10 mg/L (200 Feq/L) is the generally accepted level that denotes sensitivity to acid rain. Approximately 85 percent of all of New Hampshire's lakes and ponds are sensitive to acid rain based on this criterion.

What pH level is considered detrimental to aquatic organisms? Although most adult game fish are not directly impacted until the pH falls below 5.0, investigators (particularly the work of Dr. Schindler and his colleagues at the Freshwater Institute in Canada) have demonstrated that impacts begin to occur to important food chain organisms at pH 6.0. These impacts can result in an inadequate diet and eventual elimination of game fish. While 80 percent of the lakes have satisfactory summer pH values (pH >6.0), only 55 percent of the winter values are satisfactory. This is because pH is influenced by the carbonate equilibrium system. The dominance of photosynthesis over respiration during the summer removes CO_2 from the water and causes the pH to rise. The predominance of respiration (including decomposition) in the winter adds CO_2 to the water and the pH falls. Since organisms are just as dead whether they're exposed to lethal conditions for 1 month or for 12 months of the year, the winter or worse case condition is the more important.

High Acidity Lakes

With the understanding discussed above (that impacts from acidity begin to occur at pH 6.0) a pH of 5.0 or less, or an alkalinity of 0 mg/L or less, was used as the definition of lakes affected by high acidity. In addition, color was also used to distinguish acid rain caused acidity (color <35) from natural acidity (color ≥35). Unlike the previous section, in which impaired, threatened, and use support status was based on summer epilimnetic data, this section evaluates data from all depths and all seasons. Only significant lakes are evaluated and any lake is counted if at least one data point meets the criteria for high acidity.

Table III-5-12 suggests that approximately 11 percent of the State's lakes, representing approximately 3 percent of the surface area (acid ponds tend to be small), experience highly acidic conditions (pH ≤ 5 or ANC ≤ 0) at some depth or during some season. The source of the acid in these acid ponds is split approximately 50:50 between acid rain and natural sources in terms of numbers of lakes, and 55:45 in terms of lake area.

Acid Lakes and Toxicity

Acid waters can be toxic both directly from the high hydrogen ion concentration (low pH) and indirectly by mobilizing metals. Aluminum, in particular, tends to be leached from the soils by acid waters. High aluminum levels cause fish to suffocate by creating a mucous clogging of the gills. The speciation of the aluminum (ionic, aluminum hydroxide, etc) is important in determining its toxicity.

Table III-5-12
High Acid Lakes

	Number	Percent	Area (acres)	Percent
Lakes Assessed	697	100	156,197	100
Acid Rain Caused High Acidity	37	5	2,715	1.7
Natural High Acidity	39	6	2,242	1.4
Total of High Acid Lakes	76	11	4,957	3.2

Aluminum concentrations are available only from the remote ponds and 20 non-remote ponds, which have been sampled annually since 1982, and only total dissolved aluminum values were measured. An aluminum value of 0.25 mg/L or greater is considered toxic within the pH and calcium ranges encountered in the above sampled waters.

As shown in Table III-5-13, 12 % (7 ponds) of the remote, mostly high elevation ponds, representing nearly 6 % (62 acres) of the remote pond surface area, had toxic aluminum concentrations ($Al \geq 0.25$ mg/L) using the most recent data. Over 40 % (24 ponds) of the remote ponds, and over 30 % (331 acres) of the remote pond surface area had toxic levels of aluminum at least once during the 18 years of sampling. The non-remote ponds show a different story. No ponds had toxic aluminum levels in 1999 and only one pond had a toxic level at any time. That pond is Russell Pond in Woodstock, which is accessible but relatively high elevation and remote from development, and it had only one value (.255 mg/L) above the toxic level during the study period.

Mitigation

New Hampshire has no plans to mitigate the aquatic impacts of acid deposition. The Department of Environmental Services, as well as the Governor and Congressional delegation, strongly supported the Clean Air Act Amendments of 1990 to reduce sulfur dioxide and nitrogen oxide emissions, and continue to support state, regional and national efforts to further reduce acid-causing emissions. It made no sense to treat the symptoms of the problem without treating the causes. The only valid reason for liming a lake is to protect a commercial fishery, a heritage strain of fish for broodstock or a threatened or endangered fish species until such time as acid rain controls are in place. This situation does not exist in New Hampshire.

New Hampshire has legislation which reduces in-state sulfur emissions. With the State and federal acid rain controls now being implemented, New Hampshire is in an ideal situation to demonstrate the effects of those controls on the most sensitive lakes.

Table III-5-13
High Aluminum Lakes

	Number	Area (acres)
Remote ponds assessed	59	1083
Remote ponds with toxic aluminum levels (*most recent data*)	7	62
Remote ponds with toxic aluminum levels (*all data*)	24	331
Non-remote ponds assessed	20	4715
Non-remote ponds with toxic aluminum levels (*most recent data - 1999*)	0	0
Non-remote ponds with toxic aluminum levels (*all data*)	1	39

5.2.8 Toxic Effects on Lakes

Lake Water

The overall discussion of toxics in surface waters can be found in Chapter 8 of Part III. In this section specific information on toxics in lakes is presented.

The previous section on acid effects presented the number of lakes and surface area routinely monitored for toxics, specifically aluminum. Using the most recent values, twelve percent of the remote ponds had potentially toxic levels of aluminum, presumably due to acid conditions. None of the 20 low elevation lakes had toxic aluminum concentrations.

High hydrogen ion concentrations (low pH) can also have a direct adverse impact on aquatic organisms. Section 5.2.5 discussed impaired lakes, some of which were impaired because of low pH. Of the 5,010 acres of lakes listed as not fully supporting fishable waters because of pH (Table III-5-9), a total of 4,958 acres were because of low pH and are listed in Table III-5-10 with a source of the acid being atmospheric deposition. The remaining 52 acres were impaired because of pH exceedances (above pH 8) although, as discussed earlier, it is likely that these sporadic exceedances do not cause toxicity.

The New Hampshire Department of Health and Human Services, Division of Public Health Services issued a statewide fishing advisory in 1994. The advisory was issued because of the presence of mercury in freshwater fish tissue. The advisory applies to all fish species and all waterbodies, and recommends that women of child-bearing age and young children (< 6 years old) consume no more than one meal per month and that the general public consume no more than four meals per month.

To the best of DES' knowledge there were no pollution-caused fish kills in lakes or confirmed cases of water-borne diseases from lakes during the reporting cycle.

Bathing Beach closures and/or postings were discussed in Section 5.2.5.

Lake Sediment

Sediment cores have been collected from approximately 45 lakes in the State, and analyzed for heavy metals and phosphorus. Lakes sampled include remote ponds and urban ponds, acid ponds and non-acid ponds, and lakes with and without motor boat activity, including directly within marinas. The metal results have not been analyzed in detail, but some general observations can be made.

A typical sediment profile for lead shows the maximum values from about 2 centimeters to 20 cm, with a sharp decrease below 20 cm. The 20 cm depth probably represents the introduction of the widespread use of leaded gasoline. The decrease in lead levels in the 0 to 2 cm layer represents the phase out of leaded gasoline. Interestingly, this typical profile is also evident in remote ponds with no motor boats. Apparently, much of the lead deposition in lake sediments is from atmospheric deposition.

A cursory review of the sediment metal data reveals no obvious relationship to acidity levels, motor boat activity, or development of the watershed. There is no evidence that metal levels in lake sediments are toxic to organisms in the overlying water or on the bottom. Sediment samples collected directly in marinas did show toxicity to bottom organisms (*Chironomus*), but this toxicity appeared to be related to hydrocarbon levels (specifically methyl t-butyl ether) rather than heavy metals levels.

5.2.9 Trends in Lake Water Quality

This discussion of lake trends looks at acid rain trends and at general trophic trends. Both short and long-term trends are discussed, although long-term is a relative term - it is still very much short-term with respect to the lake age.

Acid Rain Trends

Long-term trends were evaluated in the 1996 305(b) report by comparing current data to data collected in the 1930s and '40s by the NH Fish and Game Department. Here, long-term represent a 40 to 60 year period. In general, the analysis showed that both pH and ANC have been relatively stable over the time period. The reader is referred to the 1996 report for a more detailed discussion.

Short-term trend data was evaluated by DES in 1999 as part of the New England Governors/Eastern Canadian Premiers Acid Rain Action Plan. Annual data from the remote and outlet ponds monitoring programs (see p. III-5-5) were evaluated for trends, over both a 10 year (1990-'99) and a 17 year (1983-'99) period. The Spearman Rank Order correlation was used to determine trends, with a $P < 0.05$ indicating a trend exists.

Table III-5-14
pH Trends

Trend	# of lakes	
	'83 - '99	**'90 - '99**
Improving	1	0
Stable	30	30
Degrading	4	6
Totals	**35**	**36**

For pH, most ponds showed no trend and there was little difference between the two time periods analyzed. All but one pond showing a pH trend had a degrading trend.

The time period was important, however, for ANC. Approximately one-third (11) of the ponds showed an improving trend over the 17 year period, but no ponds improved over the 10 year period. Ten of the 11 ponds showing improvement were outlet ponds, representing fully one-half of the outlet ponds dataset. It appears that ANC improved in many of the outlet ponds during the 1980s but remained stable, and even a few decreased, during the 1990s.

Table III-5-15
ANC Trends

Trend	# of lakes	
	'83 - '99	**'90 - '99**
Improving	11	0
Stable	24	33
Degrading	0	3
Totals	**35**	**36**

Trophic Trends

Trophic trends were evaluated using two separate sets of data. The first involved the lake trophic survey program (p. III-5-5). Trophic data evaluated included bottom dissolved oxygen, Secchi disk transparency, chlorophyll, macrophyte abundance and trophic points. Data collected on single days 10 to 20 years apart were visually compared for significant (not statistically) changes in trophic values. Over the course of this 25 year monitoring program, a total of 249 lakes or lake stations were sampled on at least two and sometimes three different dates. This is categorized as a long-term trend.

As shown in Table III-5-16, only 10 lakes showed a significant change and eight of those were improvements. Improvements were often because of Section 314 lake restoration projects (e.g., Kezar Lake), Section 319 implementation projects (e.g., Crystal Lake, Manchester) or other projects to restore lake quality. Clearly an analysis such as this (based on data from 2 or 3 widely spaced dates) can not detect subtle changes. More frequently collected data is required.

Table III-5-16
Lake Trophic Trends

Trend	long-term
	No. of Lakes
Improving	8
Stable	239
Degrading	2
Totals	**249**

The second set of data used to evaluate trophic trends is the VLAP data. Here, data is collected every year and several times during the summer of each year. Only lakes with at least five years of data were assessed. Trends in chlorophyll, Secchi disk transparency and total phosphorus were determined for each lake, and then an average of the three trends was determined for each lake and reported in the table below. Trends were determined by visually looking at a graph of the data; they do not necessarily have a statistical significance. These trends are listed as short-term.

As can be seen from Table III-5-17, over 80 % (85) of the lakes and 87 % (71,366) of the lake area are stable in terms of trophic status trends. An approximately equal number of lakes show an improving trend as show a degrading trend.

Table III-5-17
Trophic Trends

Trend	short-term	
	No. of lakes	Acreage
Improving	10	5,313
Stable	85	71,366
Degrading	10	5,486
Totals	**105**	**82,165**

Overall we can say that most New Hampshire lakes have relatively stable water quality. This is not unexpected given the fact that the lakes were created some 10,000 years ago when the last glacier receded, and we are generally looking at a 10 to 50 year time period for trends. Clearly events can occur that can alter lake quality in a relatively short time: the introduction of an exotic species, a point source discharge, or a major change in land-use in the watershed. Absent these events, lake quality generally does not change rapidly and this is the reason we are confident that our lake monitoring data, at least up to 10 years old and probably older, accurately reflects current conditions.

PART III, CHAPTER 6

WATER QUALITY ASSESSMENT OF COASTAL WATERS AND ESTUARIES

6.1 INTRODUCTION

In this chapter, the water quality of New Hampshire's estuaries (i.e., shellfish waters) and coastal waters is reviewed. New Hampshire has approximately 18 miles of scenic shoreline along the Atlantic Ocean, about 217 miles of estuarine shoreline and approximately 21.24 square miles of estuaries, harbors and bays that include Great and Little Bay, Rye and Hampton harbors and the Piscataqua River, which is a major estuary/tidal river complex that forms the border with Maine. Approximately 54 square miles of open ocean are also under the State's jurisdiction. New Hampshire's coastal waters and estuaries have long been recognized as a valuable resource which have been, and continue to be, the subject of numerous studies designed to protect and preserve these important assets.

In accordance with EPA guidance, the following subjects are addressed in this chapter. First, use support summary tables for coastal waters and estuaries are presented and discussed in Section 6.2. Definitions of terms used in the tables are provided in Part III, Chapter 3. This is followed by discussions of eutrophication in Section 6.3, habitat modification in Section 6.4, changes in living resources in Section 6.5, toxic contamination in Section 6.6, and pathogen contamination in Section 6.7. Lastly, in Section 6.8, a case study is presented as an example of New Hampshire's continued commitment towards improving the quality of its estuaries.

6.2 USE SUPPORT SUMMARY STATISTICS

6.2.1 Coastal Shoreline

Summary statistics for New Hampshire’s 18 miles of coastal shoreline are shown in Tables III-6-1 through III-6-4. As shown in Table III-6-1, and as reported in 1998, none of the 18 miles of coastal shoreline is considered to be fully supporting of all uses. This is due to the fish consumption advisory for bluefish which was issued in 1987 for all tidal waters in New Hampshire due to high levels of PCBs (see Part III, Chapter 8) and an administrative closure of the coastal shoreline waters to shellfishing. As shown in Table III-6-2, all other uses (i.e., swimming, aquatic life, and secondary contact) are fully supported.

The bluefish advisory is based on bluefish caught in Massachusetts and Rhode Island. Although no bluefish were taken from New Hampshire waters, the advisory was issued because bluefish are very migratory and because people from New Hampshire may fish in the waters of neighboring states. As discussed in Chapter 8, although PCBs were banned in the United States in 1970s, they may still be found in the environment because they are extremely persistent. The

Table III-6-1
Summary of Fully Supporting, Threatened and Impaired Coastal Shoreline Waters

Degree Of Use Support	Assessment Basis		Total Assessed (Miles)
	Evaluated (Miles)	Monitored (Miles)	
Size Fully Supporting All Assessed Uses	0.0	0.0	0.0
Size Fully Supporting All Assessed Uses but Threatened for at Least One Use	NA	NA	NA
Size Impaired for One or More Uses	18.0	0.0	18.0
Size Not Attainable for Any Use and Not Included in the Line Items Above	0.0	0.0	0.0
Total Assessed	18.0	0.0	18.0

NA = Not Assessed

Table III-6-2
Individual Use Support Summary For Coastal Shoreline Waters

Use	Size Assessed (Miles)	Size Fully Supporting (Miles)	Size Fully Supporting but Threatened (Miles)	Size Partially Supporting (Miles)	Size Not Supporting (Miles)	Size Not Attainable (Miles)
Aquatic Life	18.0	18.0	NA	0.0	0.0	0.0
Fish Consumption	18.0	0.0	NA	18.0	0.0	0.0
Shellfishing	18.0	0.0	NA	18.0	0.0	0.0
Swimming	18.0	18.0	NA	0.0	0.0	0.0
Secondary Contact	18.0	18.0	NA	0.0	0.0	0.0
Drinking Water	*	*	*	*	*	*
Agricultural	*	*	*	*	*	*
Cultural or Ceremonial	*	*	*	*	*	*

Asterisk (*) = category is not applicable.
Dash (-) = category applicable but little to no data is available.
Zero (0) = category is applicable, but size of waters in this category is zero.
NA = Not Assessed

Table III-6-3
Coastal Shoreline Waters Not Fully Supporting Uses By Various Cause Categories

Cause Category	Size of Waters by Contribution to Impairment			
	Major (Miles)	Moderate/Minor (Miles)	Total (Miles)	Percent (%)
Cause unknown (administrative)	0.0	18.0	18.0	50.0%
Unknown toxicity	0.0	0.0	0.0	0.0%
Pesticides	0.0	0.0	0.0	0.0%
Priority organics	0.0	0.0	0.0	0.0%
Nonpriority organics	0.0	0.0	0.0	0.0%
PCBs	0.0	18.0	18.0	50.0%
Dioxins	0.0	0.0	0.0	0.0%
Metals	0.0	0.0	0.0	0.0%
Ammonia	0.0	0.0	0.0	0.0%
Cyanide	0.0	0.0	0.0	0.0%
Sulfates	0.0	0.0	0.0	0.0%
Chlorine	0.0	0.0	0.0	0.0%
Other inorganics	0.0	0.0	0.0	0.0%
Nutrients	0.0	0.0	0.0	0.0%
pH	0.0	0.0	0.0	0.0%
Siltation	0.0	0.0	0.0	0.0%
Organic enrichment/low DO	0.0	0.0	0.0	0.0%
Salinity/TDS/chlorides	0.0	0.0	0.0	0.0%
Thermal modifications	0.0	0.0	0.0	0.0%
Flow alterations	0.0	0.0	0.0	0.0%
Other habitat alterations	0.0	0.0	0.0	0.0%
Pathogen indicators	0.0	0.0	0.0	0.0%
Radiation	0.0	0.0	0.0	0.0%
Oil and grease	0.0	0.0	0.0	0.0%
Taste and odor	0.0	0.0	0.0	0.0%
Suspended solids	0.0	0.0	0.0	0.0%
Noxious aquatic plants (macrophytes)	0.0	0.0	0.0	0.0%
Excessive Algal Growth	0.0	0.0	0.0	0.0%
Total toxics	0.0	0.0	0.0	0.0%
Turbidity	0.0	0.0	0.0	0.0%
Exotic species	0.0	0.0	0.0	0.0%
Total	0.0	36.0	36.0	100.0%

Table III-6-4
Coastal Shoreline Waters not Fully Supporting Uses
Affected by Various Source Categories

Source Category	Contribution to Impairment			
	Major (Miles)	Moderate/Minor (Miles)	Total (Miles)	Percent (%)
Industrial Point Sources	0.0	0.0	0.0	0.0
Municipal Point Sources	0.0	0.0	0.0	0.0
Combined Sewer Overflows	0.0	0.0	0.0	0.0
Collection System Failure (Cross Connections)	0.0	0.0	0.0	0.0
Domestic Wastewater Lagoon	0.0	0.0	0.0	0.0
Agriculture	0.0	0.0	0.0	0.0
Crop-related sources	0.0	0.0	0.0	0.0
Grazing -related sources	0.0	0.0	0.0	0.0
Intensive Animal Feeding Operations	0.0	0.0	0.0	0.0
Silviculture	0.0	0.0	0.0	0.0
Construction	0.0	0.0	0.0	0.0
Urban Runoff/Storm Sewers	0.0	0.0	0.0	0.0
Resource Extraction	0.0	0.0	0.0	0.0
Land Disposal (Landfills)	0.0	0.0	0.0	0.0
Hydromodification	0.0	0.0	0.0	0.0
Habitat Modification (non-hydromod)	0.0	0.0	0.0	0.0
Marinas and Recreational Boating	0.0	0.0	0.0	0.0
Erosion from Derelict Land	0.0	0.0	0.0	0.0
Atmospheric Deposition	0.0	0.0	0.0	0.0
Waste Storage/Storage Tank Leaks	0.0	0.0	0.0	0.0
Leaking Underground Storage Tanks	0.0	0.0	0.0	0.0
Highway Maintenance and Runoff	0.0	0.0	0.0	0.0
Spills (Accidental)	0.0	0.0	0.0	0.0
Contaminated Sediments	0.0	0.0	0.0	0.0
Debris and Bottom Deposits	0.0	0.0	0.0	0.0
Internal Nutrient Cycling (primarily lakes)	0.0	0.0	0.0	0.0
Sediment Resuspension	0.0	0.0	0.0	0.0
Natural Sources[2]	0.0	0.0	0.0	0.0
Recreational and Tourism Activities	0.0	0.0	0.0	0.0
Salt Storage Sites	0.0	0.0	0.0	0.0
Groundwater Loadings	0.0	0.0	0.0	0.0
Groundwater Withdrawal	0.0	0.0	0.0	0.0
Other (Administrative)	0.0	18.0	18.0	50.0
Unknown Source	0.0	18.0	18.0	50.0
Sources Outside State Jurisdiction/borders	0.0	0.0	0.0	0.0
Total	0.0	36.0	36.0	100.0

source of PCBs is listed as unknown in Table III-6-4, since the exact source cannot be identified at this time.

With regards to shellfishing, the coastal shoreline waters are shown as impaired because of a decision made in 1998 by the New Hampshire Department of Health and Human Services (DHHS) to close all potential shellfishing areas where adequate documentation is not available to support opening the beds, as prescribed by the 1997 National Shellfish Sanitation Program (NSSP) Guide for the Control of Molluscan Shellfish, by the U.S. Department of Health and Human Services, Food and Drug Administration. In the past, the coastal shoreline and open ocean waters with the State's jurisdiction have been open to shellfishing primarily because of the high dilution which is available. Although there is no evidence of bacterial contamination, a sanitary survey of this area had not been conducted within the past three years in accordance with NSSP guidelines. Where sanitary surveys have not been conducted, NSSP guidelines require the shellfish growing areas to be classified as "unclassified" and closed to shellfishing. In accordance with NSSP guidelines for the classification of shellfish waters, the DHHS, in 1998, reclassified the coastal and open ocean waters from approved to unclassified which effectively closed these areas to shellfishing. Since the closure is primarily for administrative reasons and not because of a measured decrease in water quality, the cause and source are shown as "administrative" in Tables III-6-3 and III-6-4.

In 1999, the DHHS initiated a sanitary survey of the outer coastal waters, which DES plans to complete in 2000. It is expected that results of the survey will allow most of the coastal and open ocean waters to be reopened for shellfishing.

6.2.2 Open Ocean Waters

Summary statistics for open ocean waters within the State's jurisdiction are presented in Tables III-6-5 through III-6-8. As shown, all 54 square miles of the State's open ocean waters are categorized as partially supporting of fish and shellfish consumption uses. All other uses (i.e., swimming, aquatic life and secondary contact) are considered to be fully supporting as shown in Table III-6-6. Causes and sources of nonsupport are the same as those presented in the previous section (6.2.1) for coastal shoreline waters.

6.2.3 Coastal Estuaries (Shellfish Waters)

Use support summary statistics for coastal estuaries (i.e., shellfish waters) are presented in Tables III-6-9 through III-6-12. As discussed in Part II, Chapter 2, the total area of estuaries was changed this year from 28.2 square miles to 21.24 square miles. The new estimate is considered more accurate because it is based on 1:24,000 scale mapping and was computer generated.

Similar to the 1998 305(b) report, none of the estuaries are reported to be fully supporting of all uses this year. As shown in Table III-6-10, all estuaries are considered to be fully supporting for secondary contact recreation uses, whereas the uses of fish and shellfish consumption, aquatic life and swimming, are not. All 21.24 square miles are considered partially supporting for fish consumption whereas 7.79 square miles (36.7 percent) and 13.45

Table III-6-5
Summary of Fully Supporting, Threatened and Impaired Open Ocean Waters

Degree Of Use Support	Assessment Basis		Total Assessed (Miles)	Percent (%)
	Evaluated (Miles)	Monitored (Miles)		
Size Fully Supporting All Assessed Uses	0	0	0	0.0
Size Fully Supporting All Assessed Uses but Threatened for at Least One Use	NA	NA	NA	NA
Size Impaired for One or More Uses	54	0	54	100.0
Size Not Attainable for Any Use and Not Included in the Line Items Above	0	0	0	0.0
Total Assessed	54	0	54	100.0

NA = Not Assessed

Table III-6-6
Individual Use Support Summary For Open Ocean Waters

Use	Size Assessed (Sq. Miles)	Size Fully Supporting (Sq. Miles)	Size Fully Supporting but Threatened (Sq. Miles)	Size Partially Supporting (Sq. Miles)	Size Not Supporting (Sq. Miles)	Size Not Attainable (Sq. Miles)
Aquatic Life	54	54	NA	0	0	0
Fish Consumption	54	0	NA	54	0	0
Shellfishing	54	0	NA	54	0	0
Swimming	54	54	NA	0	0	0
Secondary Contact	54	54	NA	0	0	0
Drinking Water	*	*	*	*	*	*
Agricultural	*	*	*	*	*	*
Cultural or Ceremonial	*	*	*	*	*	*

Asterisk (*) = category is not applicable.
Dash (-) = category applicable but little to no data is available.
Zero (0) = category is applicable, but size of waters in this category is zero.
NA = Not Assessed

Table III-6-7
Open Ocean Waters Not Fully Supporting Uses By Various Cause Categories

Cause Category	Size of Waters by Contribution to Impairment			
	Major (Sq. Miles)	Moderate/Minor (Sq. Miles)	Total (Sq. Miles)	Percent (%)
Cause unknown (Administrative)	0.0	54.0	54.0	50.0
Unknown toxicity	0.0	0.0	0.0	0.0
Pesticides	0.0	0.0	0.0	0.0
Priority organics	0.0	0.0	0.0	0.0
Nonpriority organics	0.0	0.0	0.0	0.0
PCBs	0.0	54.0	54.0	50.0
Dioxins	0.0	0.0	0.0	0.0
Metals	0.0	0.0	0.0	0.0
Ammonia	0.0	0.0	0.0	0.0
Cyanide	0.0	0.0	0.0	0.0
Sulfates	0.0	0.0	0.0	0.0
Chlorine	0.0	0.0	0.0	0.0
Other inorganics	0.0	0.0	0.0	0.0
Nutrients	0.0	0.0	0.0	0.0
pH	0.0	0.0	0.0	0.0
Siltation	0.0	0.0	0.0	0.0
Organic enrichment/low DO	0.0	0.0	0.0	0.0
Salinity/TDS/chlorides	0.0	0.0	0.0	0.0
Thermal modifications	0.0	0.0	0.0	0.0
Flow alterations	0.0	0.0	0.0	0.0
Other habitat alterations	0.0	0.0	0.0	0.0
Pathogen indicators	0.0	0.0	0.0	0.0
Radiation	0.0	0.0	0.0	0.0
Oil and grease	0.0	0.0	0.0	0.0
Taste and odor	0.0	0.0	0.0	0.0
Suspended solids	0.0	0.0	0.0	0.0
Noxious aquatic plants (macrophytes)	0.0	0.0	0.0	0.0
Excessive Algal Growth	0.0	0.0	0.0	0.0
Total toxics	0.0	0.0	0.0	0.0
Turbidity	0.0	0.0	0.0	0.0
Exotic species	0.0	0.0	0.0	0.0
Other (specify)	0.0	0.0	0.0	0.0
Total	0.0	108.0	108.0	100.0

Table III-6-8
Open Ocean Waters not Fully Supporting Uses
Affected by Various Source Categories

Source Category	Contribution to Impairment			
	Major (Sq. Miles)	Moderate/Minor (Sq. Miles)	Total (Sq. Miles)	Percent (%)
Industrial Point Sources	0.0	0.0	0.0	0.0
Municipal Point Sources	0.0	0.0	0.0	0.0
Combined Sewer Overflows	0.0	0.0	0.0	0.0
Collection System Failure (Cross Connections)	0.0	0.0	0.0	0.0
Domestic Wastewater Lagoon	0.0	0.0	0.0	0.0
Agriculture	0.0	0.0	0.0	0.0
Crop-related sources	0.0	0.0	0.0	0.0
Grazing -related sources	0.0	0.0	0.0	0.0
Intensive Animal Feeding Operations	0.0	0.0	0.0	0.0
Silviculture	0.0	0.0	0.0	0.0
Construction	0.0	0.0	0.0	0.0
Urban Runoff/Storm Sewers	0.0	0.0	0.0	0.0
Resource Extraction	0.0	0.0	0.0	0.0
Land Disposal (Landfills)	0.0	0.0	0.0	0.0
Hydromodification	0.0	0.0	0.0	0.0
Habitat Modification (non-hydromod)	0.0	0.0	0.0	0.0
Marinas and Recreational Boating	0.0	0.0	0.0	0.0
Erosion from Derelict Land	0.0	0.0	0.0	0.0
Atmospheric Deposition	0.0	0.0	0.0	0.0
Waste Storage/Storage Tank Leaks	0.0	0.0	0.0	0.0
Leaking Underground Storage Tanks	0.0	0.0	0.0	0.0
Highway Maintenance and Runoff	0.0	0.0	0.0	0.0
Spills (Accidental)	0.0	0.0	0.0	0.0
Contaminated Sediments	0.0	0.0	0.0	0.0
Debris and Bottom Deposits	0.0	0.0	0.0	0.0
Internal Nutrient Cycling (primarily lakes)	0.0	0.0	0.0	0.0
Sediment Resuspension	0.0	0.0	0.0	0.0
Natural Sources	0.0	0.0	0.0	0.0
Recreational and Tourism Activities	0.0	0.0	0.0	0.0
Salt Storage Sites	0.0	0.0	0.0	0.0
Groundwater Loadings	0.0	0.0	0.0	0.0
Groundwater Withdrawal	0.0	0.0	0.0	0.0
Other (Administrative)	0.0	54.0	54.0	50.0
Unknown Source	0.0	54.0	54.0	50.0
Sources Outside State Jurisdiction/borders	0.0	0.0	0.0	0.0
Total	0.0	108.0	108.0	100.0

square miles (63.3 percent) of the estuaries are considered partially and nonsupporting respectively of shellfish consumption uses. Approximately 99.2 percent of the estuaries are fully supporting of aquatic life while 0.16 square miles (0.8 percent) of estuary are partially supporting. Over 99.8 percent of the estuaries (21.2 square miles) are fully supportive of swimming, whereas the remaining 0.2 percent or 0.04 square miles (North Mill and South Mill Ponds) are not supportive of swimming.

The use of shellfish consumption is impaired for two reasons. The first is because of bacteria levels in the water column that exceed stringent federal Food and Drug Administration (FDA) levels for shellfish consumption. As shown in Table III-6-11, a total of 14.06 square miles (13.45 + 0.61) representing approximately 66.2 percent of the estuaries are impacted by bacteria, with 13.45 square miles being not supporting because they are closed year-round and approximately 0.61 square miles being partially supporting because the shellfish beds are conditionally open; that is they are open during extended periods of dry weather but are closed after there is a significant amount of rainfall. Approximately 7.18 square miles of the estuaries, located in portions of Upper and Lower Little Bay and Great Bay, are not impaired by bacteria and therefore are open to shellfishing. The 0.61 square miles that are partially supporting are located in Hampton Harbor. As discussed below, the 7.18 square miles of estuary which are not impacted by bacteria, are, however, included in the area impacted by the lobster tomalley advisory and, therefore, are considered partially supporting for shellfish consumption. Maps showing the areas which are opened, closed and conditionally opened for shellfishing due to bacteria are provided in Appendix E.

The source of most bacteria is listed as unknown in Table III-6-12. Possible sources of fecal bacteria include bird and wildlife feces, illegal waste discharges from boats, stormwater runoff, and/or CSOs. However, since the relative contribution of each cannot be determined in most cases, the source was listed as unknown. The exception to this was in North and South Mill Ponds in Portsmouth where 0.03 square miles (North Mill Pond) are believed to be due to bacterial contamination from illicit sewer connections to storm drains and 0.01 square miles (South Mill Pond) are attributed to CSOs. As discussed in Section 6.7, much work is underway to identify and abate sources of bacteria to the estuaries.

The second reason why the use of shellfish consumption is impaired is because of a shellfish consumption advisory issued in 1991 to limit or avoid consumption of lobster tomalley due to high PCB levels (see Part III, Chapter 8). This advisory impacts approximately 19.61 square miles (92.3 percent) of the estuaries and includes all estuaries north and west of Rye Harbor, which essentially are all estuaries that discharge directly or indirectly to the Piscataqua River. As mentioned above, this includes the 7.18 square miles of estuary in Little Bay , Little Harbor and Great Bay that are not impaired by bacteria.

In addition to shellfish consumption, the use of fish consumption in the estuaries is also considered to be impaired. As explained in the previous sections and in Part III, Chapter 8, this is because of a bluefish consumption advisory issued in 1989 due to PCBs in fish tissue which effects all tidal waters. As shown in Table III-6-10, the use of fish consumption is defined as being partially supporting in all 21.24 square miles of estuaries because of this advisory.

Table III-6-9
Summary of Fully Supporting, Threatened and Impaired Coastal Estuaries

Degree Of Use Support	Assessment Basis		Total Assessed (Sq. Miles)	Percent (%)
	Evaluated (Sq. Miles)	Monitored (Sq. Miles)		
Size Fully Supporting All Assessed Uses	0	0	0	0.0
Size Fully Supporting All Assessed Uses but Threatened for at Least One Use	NA	NA	NA	0.0
Size Impaired for One or More Uses	7.18	14.06	21.24	100.0
Size Not Attainable for Any Use and Not Included in the Line Items Above	0	0	0	0.0
Total Assessed	7.18	14.06	21.24	100.0

NA = Not Assessed

Table III-6-10
Individual Use Support Summary For Coastal Estuaries

Use	Size Assessed (Sq. Miles)	Size Fully Supporting (Sq. Miles)	Size Fully Supporting but Threatened (Sq. Miles)	Size Partially Supporting (Sq. Miles)	Size Not Supporting (Sq. Miles)	Size Not Attainable (Sq. Miles)
Aquatic Life	21.24	21.08	NA	0.16	0	0
Fish Consumption	21.24	0	NA	21.24	0	0
Shellfishing	21.24	0	NA	7.79	13.45	0
Swimming	21.24	21.2	NA	0	0.04	0
Secondary Contact	21.24	21.24	NA	0	0	0
Drinking Water	*	*	*	*	*	*
Agricultural	*	*	*	*	*	*
Cultural or Ceremonial	*	*	*	*	*	*

Asterisk (*) = category is not applicable.
Dash (-) = category applicable but little to no data is available.
Zero (0) = category is applicable, but size of waters in this category is zero.
NA = Not Assessed

Table III-6-11
Coastal Estuaries Not Fully Supporting Uses By Various Cause Categories

Cause Category	Size of Waters by Contribution to Impairment	
	Major (Sq. Miles)	Moderate/Minor (Sq. Miles)
Cause unknown	0.00	0.00
Unknown toxicity	0.00	0.00
Pesticides	0.00	0.00
Priority organics	0.00	0.00
Nonpriority organics	0.00	0.00
PCBs	0.00	21.24
Dioxins	0.00	0.00
Metals	0.00	0.16
Ammonia	0.00	0.00
Cyanide	0.00	0.00
Sulfates	0.00	0.00
Chlorine	0.00	0.00
Other inorganics	0.00	0.00
Nutrients	0.00	0.00
pH	0.00	0.00
Siltation	0.00	0.00
Organic enrichment/low DO	0.00	0.00
Salinity/TDS/chlorides	0.00	0.00
Thermal modifications	0.00	0.00
Flow alterations	0.00	0.00
Other habitat alterations	0.00	0.00
Pathogen indicators	13.45	0.61
Radiation	0.00	0.00
Oil and grease	0.00	0.00
Taste and odor	0.00	0.00
Suspended solids	0.00	0.00
Noxious aquatic plants (macrophytes)	0.00	0.00
Excessive Algal Growth	0.00	0.00
Total toxics	0.00	0.00
Turbidity	0.00	0.00
Exotic species	0.00	0.00
Other (specify)	0.00	0.00

Table III-6-12
Coastal Estuaries not Fully Supporting Uses
Affected by Various Source Categories

Source Category	Contribution to Impairment	
	Major (Sq. Miles)	Moderate/Minor (Sq. Miles)
Industrial Point Sources	0.00	0.00
Municipal Point Sources	0.00	0.00
Combined Sewer Overflows	0.00	0.01
Collection System Failure (Cross Connections)	0.00	0.03
Domestic Wastewater Lagoon	0.00	0.00
Agriculture	0.00	0.00
Crop-related sources	0.00	0.00
Grazing -related sources	0.00	0.00
Intensive Animal Feeding Operations	0.00	0.00
Silviculture	0.00	0.00
Construction	0.00	0.00
Urban Runoff/Storm Sewers	0.00	0.00
Resource Extraction	0.00	0.00
Land Disposal (Landfills)	0.00	0.00
Hydromodification	0.00	0.00
Habitat Modification (non-hydromod)	0.00	0.00
Marinas and Recreational Boating	0.00	0.00
Erosion from Derelict Land	0.00	0.00
Atmospheric Deposition	0.00	0.00
Waste Storage/Storage Tank Leaks	0.00	0.00
Leaking Underground Storage Tanks	0.00	0.00
Highway Maintenance and Runoff	0.00	0.00
Spills (Accidental)	0.00	0.00
Contaminated Sediments	0.00	0.00
Debris and Bottom Deposits	0.00	0.00
Internal Nutrient Cycling (primarily lakes)	0.00	0.00
Sediment Resuspension	0.00	0.00
Natural Sources[2]	0.00	0.00
Recreational and Tourism Activities	0.00	0.00
Salt Storage Sites	0.00	0.00
Groundwater Loadings	0.00	0.00
Groundwater Withdrawel	0.00	0.00
Other (Specify)	0.00	0.00
Unknown Source	13.45	21.97
Sources Outside State Jurisdiction/borders	0.00	0.00

The source of PCBs is listed as unknown in Table III-6-12 because it is not possible to determine, with certainty, where the lobsters and bluefish have acquired the PCBs. This is because PCBs are very persistent in the environment and can bioaccumulate in the food chain even at concentrations in the water column that are below detection limits (DHHS, 1989). They also tend to accumulate in the sediments where they become available to benthic organisms. Therefore it's possible that PCBs are the result of discharges that occurred many years ago and are not indicative of recent sources. In the past, PCB discharges could have originated from any one of the many industrial areas bordering the Great Bay and Piscataqua River estuaries, such as the Portsmouth Navy Shipyard and/or the former Pease Air Force Base. Because of all the uncertainty, the source of PCBs was listed as unknown.

The 0.16 square miles of estuary that are partially supporting of aquatic life are located in the Lamprey River estuary. This is based on wet weather exceedances (grab samples) of copper, lead and zinc taken in 1993. As discussed in Part III, Chapter 4 (Section 4.4), impairment based solely on metal exceedances may give a false impression of the actual impact on aquatic life because 1) clean techniques were not used to sample and analyze the samples, 2) total metals were measured instead of dissolved metals which is the more toxic form, and 3) most metal results are based on grab samples which are not always indicative of the sustained concentrations needed to cause impairment. As shown in Table III-6-12, the source of the metals is unknown. To confirm if exceedances still exist and to determine the source, if necessary, additional investigations will be conducted.

6.3 ESTUARINE EUTROPHICATION

Estuarine eutrophication, or the biological impact of increased nutrient discharge, is considered by some to be the major problem threatening the health of estuaries in the United States. In New Hampshire a considerable amount of research regarding water quality including nutrient loadings to the estuaries has been done. An excellent review of many of these studies is provided in a draft report entitled "A Technical Characterization of Estuarine and Coastal New Hampshire" prepared by the UNH Jackson Estuarine Laboratory for the New Hampshire Estuaries Project (Jones, 1997-draft) - hereinafter referred to as the Technical Characterization Study or TCS. A few of these studies and conclusions from the TCS, are discussed below.

Nutrient Loadings, Concentrations and Trends

Based on land estimates and physical structure, the National Oceanographic and Atmospheric Administration (NOAA) estimated loading rates for all the major estuaries on the east coast in 1988 (see Appendix F). This study (NOAA, 1990) suggests that the annual loadings rates of nitrogen and phosphorus to Great Bay, the State's largest estuary, are approximately 640 and 203 tons per year, respectively. These loadings are well below the average loadings of 23,170 and 3,819 tons per year of nitrogen and phosphorus respectively for all 78 estuaries evaluated in the NOAA study. Of course, a comparison of loadings alone is not necessarily indicative of the relative trophic status of an estuary as it does not account for the many physical characteristics (i.e., size, flushing rates, suspended solids concentration, etc.), which play an important role in determining the biological response of an estuary to nutrient loadings.

Nitrogen is usually the limiting nutrient in estuaries. This is supported by the 1990 NOAA study which suggests that nitrogen is the limiting nutrient in Great Bay and that nonpoint sources are the major source of nitrogen. Approximately 397 tons per year of nitrogen, which represents 62 percent of the total estimated annual nitrogen load, is attributed to nonpoint sources. Point sources are estimated to contribute approximately 243 tons/ year of nitrogen or 38 percent of the total nitrogen load. Another NOAA study (NOAA, 1994) based on effluent volume monitoring and typical wastewater concentrations of nitrogen, estimated the total nitrogen input to Great Bay to be 317 tons/year.

With regard to phosphorus, the 1990 NOAA study estimates that point sources contribute 160 tons per year or 79 percent total annual phosphorus loadings to Great Bay. Nonpoint sources are estimated to contribute 43 tons per year which represents 21 percent of the total estimated annual phosphorus loadings.

In 1993 and 1994 JEL conducted a study on the Oyster River (Jones and Langan, 1994b) which is one of several freshwater rivers that discharge to Great Bay via upper Little Bay. The only point source on the Oyster River is the Durham WWTF. JEL estimated that approximately 5.9 tons/year (48 percent) of the dissolved inorganic nitrogen in the Oyster River watershed is from point sources and 6.49 tons/year (52 percent) is from nonpoint sources. With regards to dissolved inorganic phosphate, approximately 1.86 tons per year (77 percent) was attributed to point sources and 0.56 tons/year (23 percent) to nonpoint sources.

The Complex Systems Research Center of the University of New Hampshire (CSRCUNH, 1995) conducted a study in 1994 to assess the amount and type of atmospheric nitrogen loading to Great Bay. It was concluded that the atmospheric deposition introduces at least as much, and probably considerably more nitrogen to Great Bay than do point sources such as wastewater treatment facilities. Of the atmospheric nitrogen entering the estuary, 56 percent is in the form of gas phase nitric acid (dry form), while the remainder is in the wet form of nitrate and ammonium.

Using information from the numerous local studies conducted to date, researchers at the UNH Jackson Estuarine Laboratory recently estimated total nitrogen loadings to Great Bay to be approximately 718 tons per year (Jones, 1998). This is slightly higher than the 1990 NOAA estimate of 640 tons per year discussed earlier. Nonpoint sources were estimated to contribute 345 tons per year (48 percent) and point sources 246 tons per year (41 percent). Based on work done by Mosher (Mosher, 1996), atmospheric deposition of nitrogen directly to the water surface was calculated to be 77 tons per year (11 percent).

According to the TCS (Jones, 1997), highest nitrogen concentrations in the Great Bay Estuary generally occur near the heads of tides, due either to freshwater influences (Cocheco, Salmon Falls, Oyster Rivers) or to the location of municipal WWTF outfalls near the heads of tide. Phosphate (PO4) concentrations in the Great Bay Estuary are generally low in most of the freshwater portions of the tributaries, highest in the upstream portions of the tidal rivers and lower through Great Bay, Little Bay and down to the harbor mouth. Compared to nutrient concentrations in other estuaries in the Northeast United States, the Great Bay Estuary is approximately in the middle.

With regard to trends, the TCS concludes that current nutrient concentrations (annual means, seasonal patterns, minimum and maximum concentrations) in most areas of the Great Bay Estuary, including the tidal tributaries, are similar to or lower than that which was observed in the 1970's (Jones, 1997). This is somewhat surprising in light of the dramatic increase in population from 1970 to 1990 throughout the Great Bay watershed which is often associated with increased loadings. One possible explanation is that the expected increased loading associated with increased population has been offset by improvements in municipal wastewater treatment facilities. Exceptions include the Cocheco and Salmon Falls River (in particular the freshwater portions of these rivers) where concentrations have increased in recent years.

Dissolved Oxygen

In general, the TCS (Jones, 1997) concludes that the Great Bay Estuary does not exhibit low dissolved oxygen (DO) in tidal waters. Even in the shallow upper tidal reaches of the rivers, the DO usually exceeded 5 ppm in worst case scenarios (early morning low tides in mid to late summer). In these shallow tidal waters, particularly those near marshes, periodic drops in DO are most likely a natural phenomenon.

One exception to this is in the upper portion of the Salmon Falls River Estuary where measurements taken by the Maine Department of Environmental Protection, (MDEP), indicate occasional depressed oxygen levels in the bottom layer of a deep site near Hamilton House in South Berwick. Although the surface DO was usually near 100 percent of saturation, the five meter depth was often below 50 percent saturation. Based on modeling conducted by the MDEP it is believed that low DO in the bottom waters of the Hamilton House deep hole is a natural phenomenon (MDEP, 1999).

Although tidal portions are generally all right, freshwater sections of some of the rivers, however, can experience episodes of low DO. This is the case for the Salmon Falls River where low DO is attributable to nutrient loadings from WWTFs and several dams, which impound and stagnate the flow. As mentioned in Part III, Chapter 4, a Total Maximum Daily Load Study (TMDL) was recently completed by MDEP and DES for the Salmon Falls River. As a result of this study, NPDES permits for five WWTFs are in the process of being reissued with effluent limits for phosphorus.

Eutrophication

Based on nutrient, dissolved oxygen, chlorophyll conditions and other potential indicators, the TCS (Jones, 1997-draft) concludes that there is no indication of system wide eutrophication in the Great Bay Estuary. Though nitrogen may be limiting, light is also an important limiting factor due to resuspension of the sediments and vigorous vertical mixing. Potential problems may, however, exist in the freshwater portions of some of the tidal rivers and in the upper tidal reaches of the Salmon Falls and Cocheco Rivers due to a combination of point and nonpoint source nutrient loadings, low water flows and dams which impound and stagnate the water.

Based on a review of nutrient, chlorophyll and dissolved oxygen data, in addition to a lack of any indication of eutrophication, nutrient overenrichment is not considered be an issue in Hampton Harbor (Jones, 1997-draft). This is largely due to the high rate of water exchange and short residence time of water within the estuary which make it difficult for eutrophic conditions to develop. It is estimated that 88 percent of the water in Hampton Harbor is exchanged on each tide (twice daily). Consequently, the residence time is on the order of hours which is too short to support intense phytoplankton blooms.

Although estuarine eutrophication does not appear to be an imminent problem in New Hampshire, there is the potential for future problems as population and development in the watershed increase which often result in higher nutrient loadings. Consequently research should continue to better understand the sources and magnitude of nutrient loadings, and the biological/nutrient relationship in the estuaries. With this information, management priorities can be established for limiting the nutrient load, where necessary, to ensure that the relatively high quality of estuaries in New Hampshire is maintained.

6.4 HABITAT MODIFICATION

As reported in the next chapter (Wetlands), protection of tidal wetland habitats is a major function of the DES Wetlands Bureau. The Bureau is responsible for regulating dredge and fill operations in tidal, as well as freshwater wetlands. New Hampshire has been protecting tidal wetlands since 1967 when the first statute was passed to regulate impacts to tidal wetlands.

With funding assistance from the Office of State Planning - New Hampshire Coastal Program (OSP-NHCP), the DES Wetlands Bureau is able to maintain a coastal office at the former Pease Air Force base which allows them to keep a watchful eye on coastal wetland activities. As noted in past reports, substantial effort is made each year to protect the approximate 7,500 total acres of tidal wetlands from disturbance. As discussed in Part III, Chapter 6, this reporting period is no exception. Where impacts to tidal wetlands have been allowed, compensatory mitigation has been required to make up for the loss. The result is no net loss of tidal wetlands.

Tidal habitats are further protected under the provisions of Section 401 of the Clean Water Act which is administered by DES. Under the 401 Water Quality Certification Program, projects affecting the surface waters of the State, which include wetlands, are reviewed to ensure that water quality standards are met and that effective controls and mitigation measures are required, where necessary, to protect water quality. Where wetlands are involved, Wetlands Bureau approval must first be obtained prior to 401 certification.

Protection of the aquatic habitat in Great Bay was elevated to a higher level in 1989, when Great Bay was designated the 18th National Estuarine Research Reserve in the United States. The Reserve includes 4400 acres of tidal waters and mudflats, approximately 48 miles of shoreline and over 800 acres of key land and water areas representing the range of different environments around the estuary. The highest priority of the Reserve is to preserve Great Bay through the land protection program. With federal assistance, approximately 400 acres have been protected via easements or fee simple acquisition. In addition to land protection there is also a strong emphasis on using the site for public educational and long-term research purposes to determine what needs to be done to maintain the productivity and

diversity of the estuarine environment. The Great Bay National Estuarine Research Reserve is managed by the New Hampshire Fish and Game Department (NHFG). The NHFG also manages smaller wildlife management areas located at Adams Point on the shores of Great Bay and one on the tidal portion of the Bellamy River in Dover.

Preservation of the Great Bay habitat was given an additional boost in 1992 when, as part of the closing and conversion of Pease Air Force Base in Newington, approximately 1054 acres of land bordering Great Bay was designated a National Wildlife Refuge. The primary objectives of the National Wildlife Refuge program is to maintain diversity of flora and fauna, protect areas for endangered species and to protect water resources.

With regard to trends in submerged aquatic vegetation, and as reported in the 1998 305(b) Report (NHDES, 1998b), maintaining an adequate eelgrass population in Great Bay and Little Bay remain a concern. Eelgrass is an important component of the estuarine ecosystem. Not only does it act as a filter to remove both suspended sediments and dissolved nutrients, but it also provides breeding and nursery areas for fish and shellfish. In the early 1990's, eelgrass declines in the Great Bay Estuary resulting from the wasting disease in the late 1980's were the cause of great concern. Fortunately, however, this resource is improving as studies have shown an impressive recovery of eelgrass in terms of acreage and densities (Jones, 1997-draft).

To help protect habitat in the Gulf of Maine, the Gulf of Maine Council on the Marine Environment was formed in 1989 with representatives from New Hampshire, Maine, Massachusetts, and various Canadian provinces. The mission of the Council is to maintain and enhance marine environmental quality in the Gulf of Maine and to allow for sustainable resource use by existing and future generations. The Council is not a regulatory body and does not have independent authority; rather, its role is to coordinate existing programs and to oversee joint collaborative efforts. Representatives from the New Hampshire Office of State Planning (OSP) and DES, the NHFG, and the JEL typically attend Council meetings and/or are active in Council project activities.

In 1991, the Council developed its first Action Plan to serve as a blueprint to coordinate research, resource management, and conservation education in the region by emphasizing a common, Gulf-wide focus. Major objectives of the plan included monitoring and research, coastal and marine pollution, protection of public/health, habitat protection, and public education and participation.

After five years, the original Action Plan mandated that the Council review its progress and identify where adjustments are needed to reflect changing environmental and economic trends in the region. As a result of this review it was decided to focus the Council's program activities on Gulf of Maine coastal and marine habitats for the next five years. Specifically, major goals of the Action Plan for 1996 to 2001 include:

* Protect and restore regionally significant coastal habitats
* Restore shellfish habitats
* Protect human health and ecosystem integrity form toxic contaminants in marine habitats
* Reduce marine debris
* Protect and restore fishery habitats and resources

As part of the Gulf of Maine project, habitat maps and models for a variety of species including softshell clams, blue mussels, american oysters, lobsters, smelt, herring, pollock, cod, flounder, striped bass, salmon, common terns, great blue heron, bald eagle, black duck, eelgrass, cordgrass/salt hay, and algae have been developed (USFWS, 1996) in Great Bay, New Hampshire and in Passamaquoddy Bay, New Brunswick. These pilot projects were intended to develop methods for the selection of evaluation species, for identifying and rating species habitat, for determining regionally important habitats and for use of the maps and associated information in resource conservation.

6.5 CHANGES IN LIVING RESOURCES

As reported in the 1998 305(b) Report (NHDES, 1998b), limited quantitative information is available regarding either increases or decreases in the abundance, distribution, and diversity of species along the coast or in the State's estuaries. However, based on information provided by the New Hampshire Fish and Game Department (NHFG), groundfish populations are still depressed in the Gulf of Maine due to overfishing. As a result, utilization of more plentiful but traditionally less appealing fish species is occurring. To allow the groundfish population to recover, federal rules have been implemented with time and gear restrictions and catch limits on certain groundfish species.

Based on an on-going annual survey conducted by the NHFG, the lobster population in recent years are reported to be healthy. However, according to the NHFG, the most recent state/federal agency lobster stock assessment indicates an overfished condition. To address this, new lobster management measures are being implemented (i.e., trap limits). A continuing program of lobster population assessment will gauge the effectiveness of these new restrictions.

According to the NHFG, the striped bass population continues to be healthy. Management practices, which have included fishing restrictions are credited with the rebuilt status of this population.

According to the NHFG and JEL there has been a significant decrease in young-of-the- year oysters in recent years. The decrease in oyster population is due to poor spatfall which is believed to have been caused by unfavorable environmental conditions during the summer oyster spawning and settlement period.

Also noteworthy is that two pathogenic protozoans, MSX and Dermo, are now present in Great Bay. According to the NHFG, it is likely the MSX resulted in some adult oyster mortality in 1995. MSX was previously identified in Piscataqua River oysters in 1983, however, the parasite was not believed to be responsible for any oyster mortality before 1995. Dermo was found in Great Bay oysters in 1996. Because it is at the northern limits of its range, its presence seems slight and its virulence minor.

As a result of concern over groundfish depletion in the Gulf of Maine because of increased harvesting, the Gulf of Maine Council (see Section 6.4 above) adopted the following resolution in 1995, which has been presented to both US and Canadian fisheries management agencies:

"... Be it resolved that the Gulf of Maine Council on the Marine Environment requests that fundamental principles of fisheries management for the rebuilding of groundfish stocks be followed by all fisheries managers. Such principles should include the avoidance of juvenile fish, temporal and spatial closures of spawning areas during critical periods, and ecosystem considerations... be it further resolved that the Gulf of Maine Council will undertake to encourage and support programs to acquire such additional scientific information as will benefit resource managers in developing sustainable management strategies. "

6.6 TOXICS CONTAMINATION

As discussed in Section 6.2, PCBs and various heavy metals (copper, lead and zinc) are the only toxics listed as causing impairment in tidal waters. Levels of PCBs in lobster tomalley and in the tissue of bluefish have resulted in consumption advisories, however it is suspected that this may be more of a regional issue rather than one specific to New Hampshire. The metal exceedances occurred in the Lamprey River Estuary and are based on grab samples which are not always indicative of sustained concentrations needed to cause impairment. Furthermore, these samples were not based on "clean" sampling techniques. Consequently, additional investigations should be conducted to confirm these exceedances.

Although there are only a few toxics listed as causing impairment in the tidal waters, many more potentially toxic substances have been detected but are not at levels that are considered to cause impairment. An excellent literature review of the numerous studies which have been conducted regarding toxics in the water column, sediment and fish/shellfish tissue may be found a technical characterization study (TCS) prepared for the New Hampshire Estuaries Project (Jones, 1997-draft). The TCS concludes that heavy metal and potentially toxic organic compounds are present throughout New Hampshire estuaries but that the concentrations vary. Chromium, lead, mercury, copper, zinc and PCBs are the most common contaminants whereas DDT and other pollutants are present, but not at levels that are of concern to humans and biota. Particularly elevated concentrations of potentially toxic contaminants may be found at the Seavey Island/Portsmouth Naval Shipyard although other hot spots for specific pollutants also exist.

With regard to shellfish, the Characterization Study concludes that, in addition to PCBs in lobster tomalley, other contaminants have been detected in shellfish. For example lead found in some mussels from Seavey Island has exceeded published USFDA "alert" levels (alert levels indicate that levels are higher than one might expect in a "clean" environment but are not currently at levels that are of a concern to public health). Other metals (cadmium, chromium and nickel) and organic contaminants such as PCBs, dieldrin, aldrin, chlordane, heptachlor, heptachlor epoxide, DDT and methyl mercury in these mussels are generally well below alert levels.

Historic sources such as tanneries and other industrial facilities are believed to be the source of much of the toxic materials present in New Hampshire's estuaries. These pollutants are stored in the

fine-grained sediments dispersed throughout the estuaries and can be transported through resuspension. Monitored point source discharges, pesticides, atmospheric deposition, stormwater discharges and occasional oil spills, continue to add toxics to the estuaries. Although most of the toxic substances detected in the estuaries are not presently at levels which are of immediate concern to humans and biota, the fact that sources still exist warrants continued monitoring and investigation to ensure that concentrations do not reach harmful levels.

6.7 PATHOGEN CONTAMINATION

Opening waters that are currently closed for shellfishing due to bacteria levels that exceed state and federal standards continues to be a high priority in New Hampshire. This commitment is emphasized by the designation of the State's largest estuaries into the National Estuary Program as discussed below. Since the 1994, an additional 3.05 square miles of shellfish waters have been opened that were originally closed for shellfishing because of fecal counts that exceeded NSSP standards. Approximately 2.44 square miles are located in Lower and Upper Little Bay. The remaining 0.61 square miles are located in Hampton Harbor; these beds, however, are open only during extended dry periods and are closed for five days when it rains significantly. In all, approximately 7.79 of the 21.24 total square miles of estuaries (36.7 percent) are open for shellfishing during dry weather and 7.18 square miles (33.8 percent) are open during wet or dry weather.

Although significant progress has been made since 1994 to open more shellfish beds, 14.06 square miles or approximately 66.2 percent of the State's estuaries remain closed for shellfishing either all or part of the time (i.e. when it rains). Examples of work which have been or are being done to open more shellfish beds for harvesting are discussed below. First presented, however, is a brief review of the process used to monitor, open and close shellfish beds in New Hampshire.

DES is responsible for implementation of the federal Clean Water Act at the state level, including water quality monitoring to assess conformance with established water quality standards. In 1991, changes were made to the State law regarding allowable bacterial limits in tidal waters used for the growing or taking of shellfish for human consumption (see Appendix A). Instead of specifying that the indicator and limit be "not more the than 70 coliform bacteria per 100 ml", the law now specifies that the indicator "be in accordance with the criteria recommended under the National Shellfish Sanitation Program (NSSP) Manual of Operations, United States Department of Food and Drug Administration". The NSSP describes in great detail how each state should go about operating a shellfish sanitation program that will protect the public health, and the procedures that must be followed for classifying shellfish growing waters. When states follow this program, they can engage in the interstate commerce and sale of shellfish.

Surface waters used for shellfishing must meet stringent bacteria standards established by the NSSP. It is important to recognize that these standards are much more stringent than the bacteria standards established for swimming (see Part III, Chapter 2). Consequently, although an estuary may be closed for shellfishing because of bacteria concentrations that exceed NSSP shellfish consumption

standards, it may still be possible to safely swim in the estuary. As shown below, compliance with NSSP standards can be based on either total or fecal coliform.

	Total Coliform		Fecal Coliform
Median or geometric mean no greater than:	70 MPN / 100 ml	or	14 MPN / 100 ml
and			
no more than 10 percent of the samples exceeding	230 MPN / 100 ml	or	43 MPN / 100 ml
or			
Estimated 90th Pecentile of samples do not exceed	230 MPN /100 ml	or	43 MPN / 100 ml

To approve an area for shellfishing, NSSP requires a minimum of 30 samples to be collected from each site taken either at times that represent “adverse” environmental conditions or taken under a Systematic Random sampling design.

The Division of Public Health Services of the Department of Health and Human Services (DHHS) was formerly responsible for classifying shellfish waters for the protection of public health. However, the NH Legislature transferred that responsibility from DHHS to DES in 1999.

The NSSP requires classification of all actual or potential shellfish waters, in order for the State program to be in compliance with their criteria. To properly classify waters, pollution sources must be identified, water quality must be monitored and sanitary surveys must be performed. The purpose of a sanitary survey is to evaluate all actual and potential pollution sources and environmental factors having a bearing on shellfish growing area water quality. To be in accordance with NSSP guidelines, sanitary surveys must be formally reviewed on an annual basis and reevaluated every three years. A complete sanitary survey must be conducted every twelve years. Sanitary surveys conducted in accordance with NSSP guidelines have recently been conducted in Hampton Harbor (DHHS, 1994a and DHHS, 1998b) and Great and Little Bay (DHHS, 1995 and DHHS, 1998a). Additional sanitary surveys along the Atlantic Coast, Rye Harbor, Little Harbor, and the Back Channel were initiated in 1999 and will be completed in 2000.

Depending in part on bacterial counts in the waters overlying the shellfish beds, NSSP requires that shellfish waters be classified as either "approved", "conditionally approved", "restricted", "conditionally restricted", or "prohibited". "Conditional" areas are shellfish beds that may be harvested when environmental conditions (season, rainfall, etc.) are favorable, and are closed under adverse environmental conditions. Areas designated as "conditional" must have a detailed management plan for their operation which requires significant data collection. Restricted and conditionally restricted areas can only be used for the harvest of shellfish for controlled purification. No shellfishing is allowed in areas designated as prohibited.

The New Hampshire Fish and Game Department (NHFG) is responsible for establishing and enforcing rules for shellfish harvesting. Currently, only recreational harvesting of shellfish is allowed.

Sampling of shellfish waters for bacteria is primarily conducted by the DES and NHFG with assistance from the New Hampshire Office of State Planning (OSP) and the Jackson Estuarine Laboratory (JEL) of the University of New Hampshire. Laboratory analyses are conducted by the DHHS laboratory; the only FDA-certified laboratory in the State. Since 1992, fecal coliform has been used to classify shellfish waters. Prior to that time, total coliform was used.

Initial abatement efforts focused primarily on resolving major point sources of bacteria as these are usually easier to control than nonpoint sources. Further, it was recognized that abatement of these major point sources was necessary to allow detection of the smaller sources, whose effects were masked by the larger bacterial sources. Before proceeding with specific point source control efforts, it is important to recognize that some shellfish beds located close to point sources such as wastewater treatment facilities (WWTFs) will always be closed no matter how good its compliance record. This is because NSSP standards require that prohibited areas (i.e., closure zones) be established adjacent to each WWTF outfall or other waste discharges of public health significance, in order to protect public health in the event of a WWTF failure or discharge of raw/untreated sewage. The closure zone must be sufficiently large to afford the shellfish control authority time to stop harvesting before the pollution discharge can travel through the prohibited area and into an approved shellfishing area. Factors which must be considered when determining closure zones include the location, performance and flow rate of the WWTF, dispersion, dilution and time of travel, bacteriological die-off and the adjacent area classification. To date, dye studies have been done in Hampton Harbor and on the Oyster, Lamprey and Piscataqua Rivers and modeling has been conducted by DES to determine a closure zone for the Dover WWTF. Future efforts are planned for other locations such as the Squamscott River.

WWTFs and combined sewer overflows (CSOs) represent the major potential point sources of bacteria to the estuaries. To minimize the contribution of bacteria from wastewater treatment facilities, DES in conjunction with EPA, have modified the wastewater discharge permits of all major wastewater treatment facilities to require:

* A bacteria limit of 70 total coliform at the end of the plant's discharge pipe. Imposing this stringent limit at the end of the discharge pipe assures that water quality standards should be met, even in cases of zero dilution.

* Daily testing of bacterial limits to ensure continued compliance.

* A low residual chlorine limit to ensure that chlorine required to achieve adequate bacteria kills would not create "in-stream" toxicity to aquatic life.

In addition to the permit modifications, DES has implemented the following actions to ensure that all coastal WWTFs have adequate structural equipment to disinfect wastewater without causing in-stream toxicity due to chlorine (the receiving water that each facility discharges to is shown in parentheses):

* Dover WWTF (Piscataqua River) - In accordance with a Consent Decree issued by EPA and DES, the City completed construction of a new secondary WWTF and UV system in 1991.

* Durham WWTF (tidal portion of the Oyster River) - In 1994, EPA issued an Administrative Order (AO) that required dechlorination facilities to be added. Construction was completed in 1995.

* Envirosystems and Aquatic Research Organisms (tidal portion of the Taylor River)- This is an industrial discharge located in Hampton. In 1995, the company installed a UV system in response to new permit limits issued in 1998.

* Epping WWTF (freshwater portion of the Lamprey River) - In 1995, DES completed a Total Maximum Daily Load (TMDL) study which indicates that the Town will need to design and construct an advanced wastewater treatment facility. A NPDES permit with advanced limits was reissued in February of 2000 and construction of the advanced treatment facility is expected to begin in 2001.

* Exeter WWTF (Squamscott River) - In accordance with a DES/EPA Consent Decree, the Town upgraded its WWTF and disinfection system in the early 1990s.

* Hampton WWTF (Tide Mill Creek which flows to Hampton Harbor) - In the early 1990s, the Town installed a chlorination/dechlorination system.

* Newfields WWTF (Squamscott River) - The Town installed dechlorination equipment which became operational in 1996.

* Newington WWTF (Piscataqua River) - DES issued an Administrative Order in 1994 which required the Town to upgrade its disinfection system. Improvements were completed in 1996.

* Newmarket WWTF (tidal portion of the Lamprey River) - Chlorination and dechlorination facilities were added as part of a recent upgrade of the WWTF.

* Pease Development Authority WWTF (Piscataqua River) - In 1996 the WWTF was upgraded and expanded to accommodate a proposed brewery and to provide capacity for future development. Construction included improvements to the disinfection facilities.

* Portsmouth WWTF (Piscataqua River) - In accordance with a DES/EPA Consent Decree issued in 1990, the City upgraded its primary plant in 1992. To ensure adequate disinfection, sand filters and dechlorination were added.

* Rochester WWTF (Cocheco River) - In 1995, EPA and DES negotiated a Consent Order that requires the Town to build an advanced WWTF which will include an ultraviolet (UV) disinfection system. The plant is expected to be

completed by the year 2001. While the AWT is being constructed, the City installed a dechlorination system in 1995 to ensure adequate disinfection without causing in-stream toxicity due to chlorine.

* Rollinsford WWTF (freshwater section of the Salmon Falls River) - In accordance with a DES Consent Decree, the Town rehabilitated their chlorination system and installed dechlorination in 1995.

* Rye- Prior to 1990, the Town had an untreated ocean discharge which served about 50 houses. Under a DES Consent Decree, this discharge was eliminated by conveying the wastewater to the Hampton WWTF.

* Seabrook WWTF (Ocean) - To abate pollution from failed septic systems, the Town completed construction of a new secondary WWTF in 1996 which includes chlorination and dechlorination facilities.

The other major point source of bacteria to the estuaries is from combined sewer overflows (CSOs). Portsmouth and Exeter are the two coastal communities in New Hampshire which have CSOs. Although the vast majority of CSOs in both communities have been eliminated in past years, two CSOs remain in Portsmouth and one CSO remains in Exeter. During certain wet weather events these CSOs discharge a combination of untreated wastewater and stormwater to the estuaries.

The two CSOs in Portsmouth are located on South Mill Pond which discharges to the Piscataqua River. In accordance with an EPA Consent Decree, the City has submitted a CSO Facility Plan. The City is currently separating portions of the combined sewerage system which should reduce the frequency and volume of CSO discharges to the pond. In the next two to three years, the City will update its CSO Facility plan which will include recommendations to abate pollution from the remaining CSO discharges.

The Exeter CSO discharges to Clemson Pond (a man-made holding pond) which flows to the Squamscott River. In the late eighties and early nineties, the Town separated the vast majority of its CSOs. The one CSO that remains is really an emergency overflow for the main pump station to the WWTF. When the capacity of the pump station is exceeded during wet weather events, the CSO is activated. The Town is in the process of eliminating all CSO discharges to the pond by separating the remaining portion of its combined sewerage system. This work is expected to be completed within the next two years.

In 1995, DES developed a strategy to open more shellfish beds (NHDES, 1995a), which it has begun to implement. To resolve remaining point sources of pollution, DES is going to:

(1) Take corrective actions necessary to ensure that coastal WWTF's operate their disinfection systems to consistently achieve bacterial discharge limits.
(2) Continue with efforts to abate CSOs in Portsmouth and Exeter.
(3) Conduct an inspection program to identify illegal sewer connections to storm drain systems.
(4) Assist with modeling efforts to develop "closure zones" around WWTF discharge pipes in accordance with NSSP standards.
(5) Conduct additional monitoring to determine the effectiveness of corrective actions.

In summary, facilities are already in place to treat and disinfect the vast majority of coastal point source discharges. Those that remain are being addressed. All coastal WWTFs are now capable of meeting the bacteria limit without causing chlorine toxicity in the receiving water. To date, it is estimated that about $120 million of Federal, State, and local funds has been expended to upgrade the coastal WWTFs. It should be noted however, that the $120 million includes not only the cost to improve the disinfection systems but also to rehabilitate the WWTFs as well. Rehabilitation of the WWTF, however, is sometimes necessary to ensure adequate bacterial kills. Once all improvements are completed, and assuming systems are operated properly, the major point sources should not cause or significantly contribute to violations of NSSP bacterial standards in shellfish waters. With the major point sources identified and corrective actions complete or underway, the focus of future pollution abatement in the seacoast area is now on nonpoint sources.

Over the past several years, numerous monitoring and research projects involving DHHS, DES, OSP, NHFG, scientists from JEL, and others have been conducted to identify nonpoint sources of bacteria to the estuaries. Probable nonpoint sources identified to date include stormwater runoff, on-site sewage disposal systems, and agricultural practices.

It is well documented that stormwater runoff is a major contributor of bacteria. In 1994-1995, an assessment of nonpoint source pollution in tributaries entering Great Bay was conducted by JEL, OSP, DES, and DHHS (Jones and Langan, 1994a and 1995a). Results showed that at the majority of sites, bacteria concentrations increased dramatically after it rained. Similar results have been documented on the Oyster River (Jones and Langan 1993 and 1994b), and the Exeter/Squamscott Rivers (Jones and Langan, 1995b, and OSP, 1995a). In Hampton Harbor, extensive monitoring showed a link between rainfall events and bacteria levels that exceeded NSSP standards (DHHS, 1994c). Assuming there are no untreated wastewater discharges and that all WWTFs are operating properly, it is believed that the majority of fecal bacteria found in the stormwater is from nonhuman sources such as wild or domestic animals although recent sampling conducted by the DES Nonpoint Source Section have found some bacteria sources to be from illicit sewer connections to storm drains.

Manure from farms can also be a significant source of fecal contamination. Where animals have direct contact with the surface water, manure can cause high bacteria levels during dry and wet weather.

Even where livestock are prevented from directly entering surface waters, stormwater flowing over the manure can impact nearby surface waters during wet weather unless proper precautions are made. An assessment of the potential for agricultural wastes to impact growing areas are typically included in the sanitary surveys required by NSSP before shellfish beds can be opened. An example is the sanitary survey for Great and Little Bays (DHHS, 1995) which concluded that all the farms along the shoreline of the growing area were practicing responsible management practices to prevent manure from contaminating the receiving waters, but there was still a potential for stormwater runoff from the farms to impact proposed growing area when it rains.

Since 1990, The Great Bay Hydrologic Unit Project, which is a cooperative effort between the U.S. Department of Agriculture, Natural Resources Conservation Service (NRCS) and Farm Service Agency, the Rockingham and Strafford County Conservation Districts and the DES, have helped to minimize the impact of agricultural wastes through public education and outreach, and by providing technical services in the design and construction of agricultural waste management systems. With funding from the Section 319 Nonpoint Source program, the Rockingham County Conservation District developed a manure brokerage system to address the problem of inadequate horse manure management. Compost facilities were built in various parts of the Exeter River Watershed and promotional materials and mailing lists were developed to link small farms with excess manure to compost sites.

Septic systems have also been listed as a potential source of bacteria in many of the estuaries (Jones and Langan, 1994b; Jones and Langan, 1995c). Though a suspected source in many cases, hard data to support this suspicion is lacking. This excludes the obvious cases of failed systems that are corrected right away. In 1994-1995, JEL conducted a study to determine the relationship between on site sewage disposal systems and surface water contamination in Seabrook (Jones and Langan, 1995b). The study concluded that bacterial contaminants from the tested septic systems were not transported consistently or in high quantities via groundwater.

In summary, stormwater runoff appears to be the major nonpoint source of bacteria. Though much work has been done, past efforts have often fallen short of the ultimate goal of opening more beds because of a lack of resources (funding and staff) and the very low NSSP bacterial standard for shellfish waters which makes source identification and abatement more difficult.

In July 1995, efforts to open more shellfish beds for harvesting received a tremendous lift when EPA approved the nomination of the Great Bay, Little Harbor and Hampton Harbor estuaries as part of the National Estuaries Program (NEP). The NEP was established by Congress in 1987 to protect and restore the health of estuaries while supporting economic and recreational activities. To achieve this the EPA helps to create local NEPs by developing partnerships between government agencies who oversee estuarine resources and the people who depend upon the estuaries for their livelihood. Nationwide there are 28 estuaries in the NEP. The program in New Hampshire is referred to as the “New Hampshire Estuaries Project” (NHEP).

In general, the NHEP is a multi-year planning effort, the primary goal of which is to develop and

implement a Comprehensive Conservation and Management Plan (CCMP) to improve and protect the quality of New Hampshire's estuaries. Being that "environmental quality" is a very broad and somewhat vague term, the project is focused on improving environmental quality through identifying, correcting, and preventing nonpoint (runoff) pollution to the estuaries. To enhance the success of this effort, the project will link the issues of runoff pollution to shellfish resource management issues, using shellfish as an indicator of environmental quality, as an educational tool, and as an end themselves (i.e., the project will not only seek to improve water quality (for all living resources and uses of the estuaries), but also to enhance the use and productivity of the State's shellfish resources).

The NHEP strives to involve all interested parties through its organizational structure which consists of a Policy Committee, a Management Committee and several Advisory Project Teams. In November of 1995, the Management Committee was formed, whose main responsibility is to direct the project and develop the CCMP. This committee, which is chaired by the OSP, is composed of representatives of federal, state, and local government, coastal businesses, non-government and educational organizations and the chairman of the project's advisory teams. In the winter and spring of 1996, public forums were held to solicit public input on what the focus of the NHEP work plan should be. In June 1996, the Management Committee sponsored an Estuaries Conference, which was attended by over 80 participants, to finalize major issues regarding the workplan. Since then, through numerous NHEP working groups and public meetings, NHEP has developed numerous goals, objectives, and " action plans" to improve and protect the environmental quality of the state's estuaries. These are detailed in a draft *Management Plan,* which was released for public review and comment in late 1999. The document is scheduled to be finalized in 2000.

In addition to efforts to reduce bacteria levels in the estuaries, aquaculture can also be a means of making better use of the State's shellfish resources. According to NSSP guidelines, aquaculture may be allowed in waters that are classified as restricted, as long as certain conditions are met. Using relay (moving the shellfish to clean waters for a period of time) and/or depuration (controlled purification) techniques, private aquaculture companies could make shellfish from these waters fit for human consumption. Before aquaculture can be allowed, a state must have an FDA approved commercial program. In New Hampshire, developing and implementing an approved program will require coordination among DES, DHHS, and NHFG. DES will lead the effort to develop such a program in 2000.

Since the early nineties, the State has taken positive steps to allow aquaculture in New Hampshire shellfish waters. In accordance with Chapter 209, Laws of 1993, a legislative committee was established to determine the feasibility of establishing an oyster aquaculture program in the Piscataqua River and to consider resource management issues and shellfish sanitation for all of the State's shellfish. The Committee submitted a report recommending that shellfish issues be raised to a higher priority by the State agencies involved and that changes be made to the Laws and Rules that would allow aquaculture permitting in "restricted" areas of the Piscataqua River that currently contain oyster resources. Furthermore, to ultimately allow aquaculturists to sell and ship product interstate and to provide greater protection for the public health of recreational harvesters, the Committee recommended that shellfish areas be classified in strict accordance with NSSP guidelines and that the classification program should

be adequately funded through the State General Fund. In 1995, the New Hampshire Fish and Game Department adopted rules that would allow permitting of aquacultural activities.

In 1995, the DHHS received its first aquaculture application, which was in turn submitted to the FDA for approval. The request was to allow aquaculture in the Piscataqua River. In 1996, the FDA rejected the application primarily because the State did not have shellfish rules that are in accordance with the NSSP guidelines. In 1997, the State adopted such rules and it is expected that in the future, aquaculture will be allowed in New Hampshire estuaries.

At the Isles of Shoals, UNH is conducting an "Open Ocean Aquaculture Demonstration Project" for mussels and finfish. Although the finfish can be sold, the mussels cannot because New Hampshire does not yet have a shellfish program that meets all of the federal NSSP guidelines. DES expects to submit an application requesting NSSP approval of its shellfish program by 2001.

6.8 CASE STUDY

One of the most significant events to benefit New Hampshire's estuaries occurred in 1999 with the release of the New Hampshire Estuaries Project (NHEP) draft *Management Plan*. The *Management Plan* is a working document that is designed to chart the course for the protection and enhancement of the estuaries. It is the product of a three year planning effort by approximately 75 individuals representing the interests of area citizens; recreational resource-users; the business, academic and scientific communities; local, state and federal agencies and governments; and environmental organizations. The NHEP *Management Plan* represents the State's version of the Comprehensive Conservation and Management Plan required by all National Estuary Program (NEP) participants (see Section 6.7 for a general discussion of the NEP and NHEP).

The *Plan* revolves around the following vision for the estuaries in 2005 and beyond:

* a future of cleaner water;
* regional development patterns that protect water quality, maintain open space and important habitat areas, and preserve the beauty and views of the estuaries;
* more healthy shellfish beds open to recreational harvest;
* and restoration and enhancement of important habitat areas that have been altered or degraded.

The NHEP visions of the future were then formulated as goal statements for each of the following five "priority concerns" identified by those participating in the development of the *Plan*:

1) Water Quality
2) Land Use Development and Habitat Protection
3) Shellfish Resources
4) Habitat Restoration
5) Outreach and Education

To make this vision a reality, a detailed series of steps, or Action Plans, were then developed for each of the five priority concerns. Each Action Plan includes a list of activities to achieve the desired

objective, a list of responsible parties, cost estimates and funding sources, a review of anticipated regulatory needs, the expected benefits, monitoring and/or enforcement requirements, and a priority rank. These Action Plans are the heart of the *Management Plan*.

The *Management Plan* focuses on water quality because it is related to most priority problems in the estuaries and because it is a good indicator for measuring progress. The *Plan* emphasizes, however, that although the focus is on water quality, the key to understanding and implementing the *Plan* is recognizing that all five of the priority concerns are essential aspects of the *Plan* since everything in the estuarine ecosystem is connected.

Completion of the draft *Management Plan* marks the conclusion of the primary planning phase of the NHEP project. Following public review and finalization of the *Plan* (expected in 2000), implementation will proceed as funding allows. Implementation of the Action Plans is vital for ensuring that New Hampshire's estuaries are protected, managed and used responsibly, for the benefit of present and future generations.

PART III, CHAPTER 7

WETLANDS

7.1 NEW HAMPSHIRE WETLAND RESOURCES

New Hampshire has an estimated 400,000 to 600,000 acres of non-tidal wetlands and approximately 7,500 acres of tidal wetlands (6.7 percent to 10 percent of the State). The acreage estimate for non-tidal wetlands is based on two sources; 1) LANDSAT telemetry data which is limited in resolution to wetlands that are greater than two acres in size; and 2) soils mapping data that has been completed in seven of the ten counties. Mapping based on the digital LANDSAT imagery shows that the State has approximately 396,000 acres of wetlands that are greater than two acres in size. The soils mapping completed to date suggest that approximately 10 percent of the State is Wetland. It is estimated that New Hampshire still has 50 percent of its 18th Century tidal wetlands and about 90 percent of its 18th Century non-tidal wetlands.

A summary of wetlands lost over the past two years is shown in Table III-7-1 below. The "Estimated Two Year Impact" column of the table includes those impacts that: 1) have been permitted; 2) are associated with identified violations; or 3) are estimated for unidentified violations. The unidentified violations are all probably small (several thousand square feet each), but for this table their cumulative impact is assumed to be equal to the cumulative impact of known violations (approximately 24 acres during the two year period). The Department has initiated a database to track impacts and mitigation, but the quality of that data is still untested, and is limited to permitting activities. The lower end of the range for the two year impact represents the information from that source plus a nominal 48 acres for known and unknown violations.

In addition to the creation and restoration estimated in Table III-7-1, easements were placed on approximately 1550 acres as mitigation for impacts. Most of this is buffer to natural wetlands, or complexes of uplands and wetlands, and as such protects considerable functional value that would otherwise be vulnerable to development.

The reduction in estimated overall loss for this biennium (<0.04%), compared to the 1998 estimated loss of <0.06%, is probably due as much to improved accounting as to any change in the actual rates.

7.2 NEW HAMPSHIRE WETLANDS REGULATIONS

New Hampshire was one of the first states to regulate its non-tidal wetlands, and remains one of only 14 states that do so today. New Hampshire first passed a statute regulating impacts to tidal wetlands in 1967, and the law was expanded to include non-tidal wetlands and surface waters in 1969. RSA 482-A is more inclusive than Section 404 or the Federal Clean Water Act in that it addresses both dredge and fill, requires permits for all

Table III-7-1
Extent of Wetlands by Type

Wetland Type	Estimated Acreage	Estimated Two Year Impact	Estimated Two year creation/ restoration	Estimated 2 year net loss	Percent Change
Tidal	7500	8	more than 8	0	0%
Non-Tidal	400,000 - 600,000	200 - 225	91 - 120	80 - 134	<0.04%

projects regardless of size, and has no special exemptions for agriculture or other uses. New Hampshire statute RSA 482-A gives the New Hampshire Department of Environmental Services (DES) authority to promulgate rules and regulate activities involving dredge, fill, or construction in any wetland, surface water body, sand due or tidal buffer zone in the state. The Wetlands Bureau of the DES Water Division is responsible for application review; enforcement review; and the issuance of permits, denials, orders, and other paperwork. The Bureau maintains a web site at http://www.des.state.nh.us/wetlands.htm which includes weekly permit and denial decisions, rules, law, fact sheets, application forms, and other useful information. The Bureau has offices in Concord, Gilford, and Portsmouth. Operation of the Portsmouth Office is 50 percent federally funded through the New Hampshire Coastal Program.

Appeals of Department decisions go to a Wetlands Council who's membership includes the commissioners of the departments of Safety, Transportation, Environment Services and Resources and Economic Development; the directors of the Office of State Planning, and Fish and Game; and six public members representing county conservation districts, local conservation commissions, elected municipal officials, the non-marine construction industry, the marine construction industry and environmental interests. The public members are nominated by their respective interest groups and are appointed by the Governor for three year terms. The council reviews the record developed below, and can remand decisions to the Department if it finds the Department acted in an unreasonable or unlawful manner.

The DES 401 certification program is linked to wetlands regulation by a requirement that Wetlands Bureau approval is required prior to certification for any project involving dredge, fill, or construction of a structure in wetlands or surface waters. Surface waters in wetlands are included in the State's definition of "Waters of the State", but water quality criteria have not been defined for wetlands.

The scope of New Hampshire wetlands regulation has evolved over the last 33 years, with several significant changes during the last dozen years. These changes reflect the response of the New Hampshire Legislature to an evolving understanding of both public and environmental needs in the State. In 1986 authorization was given to issue administrative fines. In 1989 the tidal buffer zone was expanded and clarified for easier

determination in the field; a minimum impact notification process was added for forestry; authorization was given to issue administrative cease and desist orders and administrative removal/restoration orders; and the Superior Court was provided with significant civil and criminal penalties and a strengthened removal/restoration authority. In 1990 a graduated fee structure was developed that benefits both the applicant and the environment. The fees provide resources for a more timely review process, and the environment benefits from the financial encouragement to minimize impacts. In 1993, legislation enabled the former Wetlands Board to delegate minimum impact permitting to the Bureau, resulting in an expedited process. In 1995 a minimum impact notification process was added for recreational trail maintenance, and in 1996, legislation was passed which transferred the major responsibilities of the Wetlands Board to the DES Wetlands Bureau. In 1997 the legislature increased the above referenced graduated fee structure from $0.025 per square foot of requested impact (no refund for denials or partial approvals) to $0.04 per square foot requested. All fees go to DES for support of the Wetlands regulatory program.

7.3 INTERACTION WITH FEDERAL REGULATIONS

On June 1, 1992, the U.S. Army Corps of Engineers issued a New Hampshire State Programmatic General Permit (NHSPGP), and at the same time revoked most Nationwide Permits for use in the State of New Hampshire. The NHSPGP has broken new ground for reasonable and efficient environmental regulation. New Hampshire was the first state to have an inclusive state-wide state programmatic permit, and the unmitigated success of the process provides an excellent example of benefits accrued by increased cooperation between federal and state agencies. Less than 1 percent of the projects approved by the Wetlands Bureau require an individual permit from the Army Corps. The NHSPGP was reissued for another five years in June, 1997, and will next be up for renewal in 2002.

The NHSPGP evolved from a recognition by the Army Corps, the U.S. Fish and Wildlife Service, and the U.S. Environmental Protection Agency that the New Hampshire wetlands law, and the Wetlands Bureau's thorough review process, provided a sound basis for streamlining federal wetlands permitting. All projects are reviewed on an individual basis, and permits are issued in three categories: minimum impact (e.g. less than 3000 square feet impact), minor (e.g. less than 20,000 square feet of impact - about ½ acre), and major impact (e.g. over 20,000 square feet of impact). The NHSPGP handles each of these New Hampshire categories as follows:

* All projects approved and classified as minimum impact by the Wetlands Bureau automatically fall under the NHSPGP, with no Corps action required. The Wetlands Bureau notifies applicants to this effect.

* Minor projects approved by the Bureau are screened by the Army Corps and the other federal agencies for possible inclusion under the NHSPGP. The Army Corps notifies the applicant within 30 days if an individual

permit is required. If the project meets the conditions of the NHSPGP, and the Army Corps does not intervene in 30 days, minor projects automatically are approved under the NHSPGP.

* Major projects approved by the Bureau are screened by the federal agencies, and the applicant is notified within 30 days whether he can proceed under the NHSPGP or whether he needs an individual Corps permit. This 30 day period is not an automatic approval for major projects; the applicant needs affirmative notification before they can proceed.

The following categories of projects are excluded from the NHSPGP, and always need an individual federal permit:

* More than three acres of fill.

* New boating facilities including marinas, yacht clubs, boat clubs, public docks, etc.

* Projects within the limits of a Corps navigation project.

* Discharge of spoils in the ocean.

* Improvement dredging in the lower Merrimack River, the Connecticut River, Lake Umbagog, or tidal waters.

* Breakwaters extending more than 50 feet from the shoreline.

* Projects adversely affecting a National Park, National Forest, National Wildlife Refuge, endangered species, or National Wild and Scenic river.

* Projects of national concern (e.g. significant wetlands fills; work that could effect archeological sites).

The process benefits everyone. The applicant is relieved of a time-consuming parallel permitting processes, and is assured that they have a federal permit (the applicant was previously at risk if they assumed coverage by a Nationwide permit). The Corps has reduced its average turn-around time on general permit decisions to 12 days (for projects that are not minimum), from a pre-NHSPGP 45 to 60 days (minimum projects have automatic federal approval). Environmental protection is enhanced by the team effort because limited federal and state regulatory resources are freed to deal with the most significant problems.

7.4 DEVELOPMENT OF WETLAND WATER QUALITY STANDARDS

In accordance with RSA 485-A:2, XIV and Env-Ws 1702.46 and Env-Ws 1702.53, (see Appendix A), wetlands are considered surface waters of the state. As such, they are protected by the state's water quality standards. Current water quality standards, however, do not include numeric criteria specific for wetlands. The surface water quality regulations do, however include the following narrative statement regarding wetlands criteria:

Env-Ws 1703.02 Wetlands Criteria.

(a) Subject to (b) below, wetlands shall be subject to the criteria listed in this part.

(b) Wherever the naturally occurring conditions of the wetlands differ from the criteria listed in these rules, the naturally occurring conditions shall be the applicable water quality criteria.

PART III, CHAPTER 8

PUBLIC HEALTH/AQUATIC LIFE CONCERNS

8.1 INTRODUCTION

This chapter discusses public health and/or aquatic life concerns in rivers, streams, estuaries and coastal waters. Information regarding the public health and/or aquatic life concerns in lakes, ponds and reservoirs may be found in Part III, Chapter 5.

8.2 WATERS AFFECTED BY TOXICS

Overall, toxic pollutants are not considered to be a major problem in the vast majority of the State's surface waters. To help guard against toxic pollution, the State adopted surface water quality regulations in 1990 which require all waters to be "free from toxic pollutants or chemical constituents in concentrations or combinations that:

a. Injure or are inimical to plants, animals, humans, or aquatic life; and

b. Persist in the environment or accumulate in aquatic organisms to levels that result in harmful concentrations in edible portions of fish, shellfish, other aquatic life, or wildlife which may consume aquatic life".

In addition to this general statement prohibiting toxics, the Surface Water Quality Regulations also include numeric levels for 129 priority pollutants. These criteria, which were developed by EPA, represent the theoretical maximum in-stream concentrations needed to protect aquatic life and human health. A copy of the State's Surface Water Quality Regulations, which were last revised in 1999, is included in Appendix B. At the present time, chemical analyses are the primary means of determining toxicity in the State’s surface waters.

To further protect surface waters from toxic pollution, all direct dischargers are required to obtain a federal NPDES permit, and a State discharge permit. Where there is a potential for the discharge to cause toxicity in the receiving water, limits for the toxics of concern are included in the discharge permit. In addition to chemical specific limits, most permittees are required to perform Whole Effluent Toxicity (WET) tests. These tests consist of laboratory bioassays where aquatic organisms are exposed to various mixtures of effluent and/or receiving water. Over the course of the test, the health of the aquatic organisms are monitored to determine if the receiving water and/or the effluent are causing toxicity.

In general, studies that involve biological assessments conducted in-stream or under conditions that simulate ambient conditions, are considered to be better indicators of toxicity than chemical analyses alone, as they account for the synergistic and antagonistic effects of the many constituents present in surface waters which may affect toxicity. Though perhaps not as good an indicator of toxicity as in-stream biomonitoring, (i.e., because they are conducted in the laboratory under simulated ambient conditions), WET tests, nevertheless, can be a valuable source of information for identifying areas where potential toxicity problems may exist and where further investigations should be conducted.

In addition to chemical analyses and WET tests, in-stream biomonitoring, including fish tissue analyses are also used to determine toxicity in aquatic environments. As discussed in Part III, Chapter 1, an in-stream biomonitoring program is well underway in New Hampshire. Although numeric biomonitoring criteria have not yet been developed for the State, biomonitoring data collected to date was used to make preliminary assessments this year based on three metrics that include a model (percent model affinity) developed by the New York Department of Environmental Conservation (NYDEC), as well as taxa richness and EPT (Ephemeroptera, Plecoptera and Trichoptera) abundance (see Part III, Chapter 3). As more data is collected in the future, it is expected that in-stream biodiversity information will play a more significant role in making water quality assessments.

Most of the fish tissue analyses done to date have been conducted by the New Hampshire Department of Health and Human Services (DHHS), as part of risk assessment studies. Fish tissue analyses are not routinely conducted in the State. Rather they are usually performed when there is a perceived risk to public health associated with consumption of fish from a certain waterbody. Once a risk assessment is completed, DHHS decides if a fish consumption advisory should be issued. More information regarding fish consumption advisories is presented in Section 8.3.1.

8.3 PUBLIC HEALTH/AQUATIC LIFE IMPACTS

8.3.1 Waters Affected By Fish Consumption Advisories

Surface waters identified as having aquatic life and/or public health impacts due to fish consumption advisories are presented in Table III-8-1. In New Hampshire, fish consumption advisories are issued by the Department of Health and Human Services (DHHS), Division of Public Health Services (DPHS). A copy of a pamphlet prepared by the DHHS entitled “How Safe is the Fish We Eat” is provided in Appendix G. It provides a good general overview of the fish advisories, the benefits of eating fish and how one can reduce the amount of contaminants in fish that are eaten. As shown in Table III-8-1, and as discussed below, there are currently five fish consumption advisories in New Hampshire.

Androscoggin River Advisory due to Dioxin

Downstream of the Pulp and Paper of America (PPA - formerly Crown Vantage, Inc.) paper mill in Berlin, an advisory has been in effect on the Androscoggin River since 1989 due to elevated levels of dioxin found in fish tissue samples taken in 1988. The primary source of dioxin is believed to be the PPA paper mills in Berlin. The advisory recommends that pregnant and nursing women avoid consumption of all fish species. All other consumers are advised to limit consumption of all fish species to one to two, eight ounce meals per year, prepared according to guidelines (DHHS, 1989). In 1994, the PPA converted its bleaching process to a much cleaner, elemental chlorine free process or ECF. As a result, dioxin measurements have

Table III-8-1
Waterbodies Affected by Fish Consumption Advisories

Name Of Waterbody	Size Affected	Type Of Fishing Advisories				Cause(s) (Pollutants of Concern)
		Avoid Consumption		Limited Consumption		
		General Population	Sub-Population	General Population	Sub-Population	
Androscoggin River (from Berlin to the NH/Me. border)	13.45 Miles	-	Yes	Yes	-	Dioxin (All species of fish)
All Inland Freshwater Bodies	10,881 miles of rivers & streams and 170,009 acres of lakes & ponds	-	-	Yes	Yes	Mercury (All species of fish)
[1] Connecticut River Main Stem (From Lake Francis Dam to the NH/MA border)	265.5 Miles	-	-	-	-	PCBs
Horseshoe Pond	45 acres	Yes	Yes	-	-	Mercury (in Large-mouth Bass)
All Estuarine Waters in NH north and west of Rye Harbor	19.54 [(2)] square miles	-	Yes	Yes	-	PCB (in Lobster Tomalley)
All tidal waters in NH	75.24 [(2)] square miles	Yes (over 20 in. or 4 lbs.)	Yes (all sizes)	-	-	PCB (in Bluefish)

Note: 1. The advisory for the Connecticut River is not a "Restricted Consumption Advisory"; rather it is an "Informational Health Advisory" indicating that fish tissues do not contain pollutant residuals at high enough concentrations to warrant restricting consumption, however contaminants have been detected.
2. Values differ from those reported in 1998 because a more accurate estimate of estuarine area was used this year (see Part II, Chapter 1).

dropped below the minimum detection level. In accordance with conditions in their federal (NPDES) and State discharge permits, the PPA has conducted four rounds of fish sampling since 1994. The latest occurred in 1996 at which time the tissue from 14 fish (seven brown bullheads and seven trout) were sampled for dioxin as well as mercury and lead. According to representatives of the DHHS, however, concentrations are not yet low enough to rescind the fish advisory. Consequently, more fish tissue testing will need to be conducted in the future.

Tidal Waters Advisory for Bluefish due to PCBs

In 1987, DHHS, as well as many other northeastern states, issued a health advisory regarding consumption of coastal bluefish which may contain harmful levels of polychlorinated biphenyls (PCBs). PCBs are oily organic compounds which may cause cancer and birth defects. Although production of PCBs was banned in the United States in 1970s, they may still be found in the environment; most likely the result of industrial pollution. According to the advisory, pregnant and nursing women, and children under 15 should avoid consuming bluefish. All other consumers should avoid eating bluefish over 20 inches or 4 pounds and prepare fish according to guidelines. The advisory is based on a study conducted by the National Oceanic and Atmospheric Administration (NOAA, 1987), which sampled 3480 bluefish along the Atlantic Coast in 1985. The results showed that none of the small and medium sized fish exceeded the FDA tolerance level for PCBs of 2 ppm. In some of the larger fish, however, the FDA tolerance level was exceeded. In New England , samples were taken from Rhode Island and Massachusetts. Though no samples were taken from New Hampshire waters, results of the NOAA study coupled with the fact that bluefish are very migratory and that people from New Hampshire may fish in neighboring waters, were considered sufficient reasons to warrant an advisory.

As mentioned, this advisory is based on data that is over 13 years old. To determine if this advisory is still warranted, new fish tissue samples need to be taken. Federal funding however would be needed to conduct such a study.

Great Bay Estuarine System Advisory for Lobster and Lobster Tomalley due to PCBs

DHHS also issued an advisory in 1991 because of PCBs found in lobsters from the Great Bay Estuarine System (GBES), which is intended to cover all estuaries north and west of Rye Harbor. According to the advisory, pregnant and nursing women should limit their consumption of lobsters and avoid the tomalley, and all other consumers should limit their consumption of the tomalley. This advisory was issued as a result of two studies. The first study (USFW, 1989) was a joint effort by the NH Division of Public Health Services and the U.S. Fish and Wildlife Service. Soft shelled clams (160 specimens), and blue mussels (300 specimens) were collected from 18 sampling locations. Lobsters (9 specimens) were collected from the Pierce Island area in the Piscataqua River. Sediment samples were taken from four locations. The shellfish samples were analyzed for heavy metals (cadmium, chromium, copper, lead, mercury, nickel and zinc) and organic compounds (PCBs and poly aromatic hydrocarbons). The results indicated that with few exceptions the levels of contaminants detected in shellfish and sediment were within the range of contaminants found elsewhere in New England, and other regions of the United States and the world. In clams and mussels however, lead was the only contaminant found to approach or exceed the National Shellfish Program alert level of 5.0 ppm. Lobsters also displayed elevated levels of PCBs and PAHs in the viscera (tomalley). The findings of this report however were not considered sufficient to support a consumption advisory because of the limited number of samples, the observation that the contaminant levels were similar to other regions in New England, and because of the many assumptions used in the risk assessment which probably overestimated the actual risks. Further monitoring was recommended.

In response, the New Hampshire Department of Health and Human Services, Division of Public Health Services and the U.S. Food and Drug Administration (FDA) conducted a follow up study in 1989-1991 (DHHS, 1991) to further study how GBES shellfish may impact human health. In 1989, 30

pounds of lobsters were collected from Little Bay. Lobster tissue and tomalley were analyzed for PCBs and pesticides. Results indicated that concentrations of PCBs in the tomalley were similar to those observed in the first study for lobsters taken from the Pierce Island area. Based on a risk assessment, it was concluded that there may be an increased cancer risk for individuals who consume approximately 50 lobsters (meat only) per year and that the estimated risk increases substantially for those persons who regularly consume the tomalley portion. Based on these considerations, it was decided that an advisory should be issued.

Horseshoe Pond Advisory for Largemouth Bass due to Mercury

In June of 1994, DHHS issued an advisory for Horseshoe Pond in Merrimack due to elevated mercury levels found in largemouth bass. Organic mercury, in the form of MeHg, is the predominant form detected in fish tissue. Once absorbed into the body, MeHg distributes readily to all tissues with the highest levels found in the kidneys. The most sensitive target organ following oral exposure to MeHg is the brain and central nervous system. Symptoms associated with MeHg poisoning can include loss of sensation in the extremities (i.e., paresthesia), loss of coordination in walking, slurred speech, diminution of vision and loss of hearing.

A risk assessment of Horseshoe Pond (DHHS, 1994b) was performed in response to citizen concerns that discharges from the New Hampshire Plating Company (NHPC), an electroplating company, was affecting the fish population and posed a risk to public health. Since 1985 all operations at NHPC have stopped. In 1993 the U.S. Fish and Wildlife Service analyzed the fish tissues of ten largemouth bass and ten brown bullheads collected from Horseshoe Pond for pesticides, PCBs and metals. The average mercury concentration in largemouth bass (0.67 ppm) was observed to be significantly greater compared to the average level observed in brown bullhead (0.13 ppm). Three of the largemouth bass, however, were found to contain mercury levels above the FDA action level of 1 ppm. Based on this, DHHS issued an advisory to the public to avoid consumption of largemouth bass taken from Horseshoe Pond. Interestingly, it was also concluded that the source of the mercury was probably not from the NHPC.

All Inland Freshwater Bodies Advisory due to Mercury

The latest fish consumption advisory was issued in December 1994 because of concerns over mercury levels found in fish throughout the State. It applies to all species of fish taken from all inland freshwater bodies in New Hampshire. The advisory came about as a result of several studies and events. The first risk assessment to determine the potential health risk attributed to mercury contaminated fish in New Hampshire was conducted by the DHHS in 1993 (DHHS, 1993). For this assessment, 38 fish samples representing seven fish species were collected from 11 lakes and ponds and two locations along the Connecticut River. Based on the results and the EPA's health risk based guidelines for mercury (i.e., the Oral Reference Dose (RfD)) in effect at the time, DHHS concluded that it was not necessary to issue a consumption advisory.

After the first risk assessment was completed in September 1993, two events occurred which prompted a reevaluation of the original assessment and the issuance of an advisory. First the EPA recommended a more protective (lower) interim RfD, which is approximately an order of magnitude lower than the original RfD ($3x10^{-4}$ mg/kg/day versus $6x10^{-5}$ mg/kg/day). The new guideline is based on a reevaluation of methyl mercury (MeHg) toxicity which revealed evidence that the fetus and possibly pregnant woman are at increased risk of adverse effects to the nervous system from exposure to MeHg.

The second reason for reevaluation was because statewide mercury - based fish consumption advisories were issued in the neighboring states of Maine in May of 1994 and by Massachusetts in September of 1994. For these reasons the original assessment was revised (DHHS, 1994e) to account for the new RfD and to reflect the results of additional fish samples representing a more diverse cross section. In all, the reassessment was based on a total of up to 100 fish sample analyses composed of 15 different fish species collected from 28 lakes or ponds and three rivers. Based on the reassessment DHHS issued a general advisory in December, 1994, for all inland freshwater bodies, recommending that women of reproductive age limit their fish consumption to one 8 ounce meal per month, that children 6 years old or younger limit their consumption to one 3 ounce meal per month and that all other consumers limit their consumption to four 8 ounce meals per month. To further help reduce exposure to MeHg, it is recommended that consumption be limited to the smaller fish.

Human related sources which may emit mercury into the atmosphere include coal combustion, smelting, and waste incineration. Although New Hampshire sources emit some amounts of mercury, it is suspected that substantial quantities are emitted in states upwind and carried east by prevailing winds. Mercury is then deposited upon the lakes and soil of New Hampshire.

Efforts are underway at the federal, state and regional levels to address mercury contamination in the environment. In 1997, EPA released the "Mercury Study Report to Congress", to help states plan for mercury mitigation (USEPA, 1997b). The report is a compilation of the best available information on the link between mercury emissions and fish contamination, the role of atmospheric transport in mercury contamination, the status of the nationwide inventory of mercury emissions, the costs and types of mercury control technologies and the health risks posed by mercury contamination.

In February of 1998 a report was issued by the Northeast States and Eastern Canadian Provinces, which took a regional look at the sources, transport and deposition, impacts, and ways to reduce mercury pollution (NESCAUM et al, 1998). The study estimated that 47 percent of the mercury deposited in the Northeast United States originates in the Northeast, while 30 percent comes from sources outside of the region and the remaining 23 percent comes from the global atmospheric reservoir. The largest source of mercury emissions in the Northeast are municipal waste combustors.

In New Hampshire, a state level mercury reduction strategy was drafted and released in October, 1998. The strategy contains 40 recommended actions to reduce mercury releases in New Hampshire, including those from medical and municipal waste incineration and power generation. Implementation of the strategy is expected to result in a 50% reduction in mercury releases by 2003, with a long-term goal of the virtual elimination of man-made mercury releases. Legislation passed in 1999 imposes a stringent mercury emissions limit on the states' largest municipal waste combustor. The strategy also emphasizes source reduction, and recently introduced state legislation on mercury-containing products focuses on dramatically reducing the use of non-essential mercury in common products and properly

managing and recycling these products so that they are not incinerated or landfilled. In addition, outreach efforts to hospitals, businesses and citizens on mercury reduction are ongoing. Although significant progress has been made since the release of the mercury reduction strategy, much remains to be done.

New Hampshire is also participating in an effort led by the New England Governors Conference and the Eastern Canadian Premiers to implement the Regional Mercury Action Plan, adopted by the Governors and Premiers in June, 1998

Connecticut River Recommendation to Prepare Fish According to Guidelines

In the DHHS pamphlet included in Appendix G, DHHS also recommends that fish caught in the Connecticut River be "prepared according to guidelines", which basically means to avoid eating the fatty portions of the fish. This recommendation was based on a preliminary study completed in 1989 by the U.S. Fish and Wildlife Service and the DHHS (USFW, 1989). Fish samples were taken from the Connecticut River in 1986 and 1987. These samples were composited by species and location and analyzed for heavy metals (cadmium, chromium, lead and mercury) and organic compounds (DDT and metabolites, polychlorinated biphenyls (PCBs), and polynuclear aromatic hydrocarbons (PAHs). A quantitative risk assessment was conducted to estimate the potential health risk from carcinogenic and noncarcinogenic fish contaminants.

Generally, the levels of each contaminant were found to be unremarkable and within ranges that have been observed in fish taken from other rivers within New England and other northeastern states. Some of the composite fish samples did, however, exceed literature values recommended for the protection of wildlife for cadmium, PCBs and chromium. The study recommends that further work be done involving more fish samples as well as sediment samples and that individual rather than composite samples be taken.

Results of the health risk assessment indicated that PCBs contribute the greatest risk. However, the PCB concentrations were all below the FDA tolerance level of 2 ppm, indicating that they would all be suitable to move through interstate commerce and then be purchased at the supermarket or restaurant. In addition, PCB levels did not appear to be any higher than levels reported in fish from other rivers in northeastern United States. In light of the above and of the potential benefits of consuming fish, DHHS chose not to issue a consumption advisory but to recommend precautions in the preparation of fish. Specifically, when preparing fish, the skin, fat belly meat and dark fat along the backbone and lateral line should be trimmed away and
during cooking, fish should be broiled, barbequed or baked on a rack so juices, which may contain fats where PCBs are most likely to concentrate, will drip off.

The effort to measure fish contaminants in the Connecticut River discussed in the 1998 305(b) report was expanded into a regional effort coordinated by NEIWPCC. Vermont, New Hampshire, Massachusetts and Connecticut are participating in this cooperative effort. Selected resident fish will be collected at eight sites along the Connecticut River and analyzed for mercury and a variety of organic contaminants. The field portion of the study is expected to be carried out during the summer of 2000. The goal of the study is to compare mercury, PCB and other organic contaminant concentrations detected in fish tissue with the concentrations reported in the aforementioned study done in 1987. The

results will be used to revise, if necessary, the human health risk assessment for fish consumption from the Connecticut River.

8.3.2 Waters Affected By Shellfishing Advisories Due To Bacteria

As shown in Table III-8-2, shellfishing bans for the recreational harvest of clams and other shellfish, effect an estimated 14.06 square miles (66.2%) of the State's estuaries. This includes 0.61 square miles located in Hampton Harbor which are classified as "conditionally approved" because it is open only during extended periods of dry weather. The shellfish beds are closed because of bacteria measurements that exceed stringent standards established by the U.S. Food and Drug Administration or because data is lacking that would allow the beds to be opened in accordance with federal shellfishing guidelines. As discussed in Part II, Chapter 1, these values differ from those reported in 1998 because more accurate methods were used this year to determine the total estuarine area as well as the area of estuaries impacted by the shellfishing ban.

Although the majority of the estuaries are closed, it is important to recognize that progress is being made to open more beds. Prior to 1994, 4.74 square miles (22.3%) of all estuaries were open. Since 1994, an additional 2.44 (11.5%) square miles have been opened in Upper and Lower Little Bay and 0.61 square miles (2.9%) in Hampton Harbor are now opened on a conditional basis as discussed above. In all, 7.18 square miles (33.8%) of estuaries are open under all conditions and 7.79 square miles (36.7%) are opened during extended periods of dry weather. Maps showing the location and classifications (i.e., approved, conditionally approved, restricted and prohibited) of the shellfish beds are provided in Appendix E. Efforts continue to open more beds by identifying and eliminating major sources of bacteria and acquiring the information needed to fill data gaps to satisfy federal shellfishing guidelines.

8.3.3 Waters Affected By Fish Kills Due To Pollution

No known fishkill incidents attributable to pollution occurred during the reporting period.

8.3.4 Waters Affected By Sediment Contamination

New Hampshire does not currently have numeric water quality criteria for sediments. Consequently, sediments are not typically sampled as part of the ambient monitoring program. With regards to rivers and streams, some limited sediment sampling was conducted in the early 1990s along the Merrimack and Piscataquog rivers in Manchester. Sediment sampling was performed as part of a study to determine the impact of combined sewer overflows on water quality. Based on the Toxicity Characteristic Leachate Procedure (TCLP) test, which is the test used to determine if sludges qualify as being hazardous, none of the sediments tested came close to be considered hazardous. Though not totally conclusive, the fact that sediments from the most

Table III-8-2
Waterbodies Affected By Shellfish Advisories Due To Bacteria

Name Of Waterbody/ Identification Number	Waterbody Type	Square Miles Affected By Shellfish Ban [2]	Total Square Miles Of Estuaries [2]
Bellamy River NHE60003120-02.0103	Estuary	0.68	0.68
Blackwater River NHE60003150-00.0103	Estuary	0.22	0.22
Cocheco River NHE60003090-00.0103	Estuary	0.25	0.25
Great Bay and Little Bay HE60003120-00.0103	Estuary	2.47	9.65
Hampton Harbor NHE60003142-01.0103	Estuary	1.41 [1]	1.41
Lamprey River NHE60003100-00.0103	Estuary	0.16	0.16
Oyster River NHE60003120-03.0103	Estuary	0.48	0.48
Piscataqua River NHE60003146-00.0103	Estuary	7.27	7.27
Rye Harbor NHE60003142-05.0103	Estuary	0.07	0.07
Salmon Falls River NHE60003050-00.0103	Estuary	0.57	0.57
Squamscott River NHE60003110-00.0103	Estuary	0.48	0.48
Total		14.06[1]	21.24

1. This value includes the 0.61 square miles of shellfish beds in Hampton Harbor which are conditionally opened during extended periods of dry weather and closed for 5 days when it rains significantly.
2. Values differ from those reported in 1998 because a more accurate estimate of estuarine area was used this year (see Part II, Chapter 1).

urbanized area of the State (Manchester) were of relatively good quality, coupled with the ambient monitoring results taken throughout the State that show very little toxicity in the water column, supports the general belief that sediment contamination is not a significant problem in New Hampshire. More research is needed however to confirm this. For information regarding sediment contamination in lakes, see Part III, Chapter 5.

8.3.5 Waters Affected By Bathing Area Closures

The Public Swimming Beach Program consists of inspecting beaches for sanitary facilities and safety, and collecting three bacteria samples from the waterfront. If high bacteria counts are found, a second round of samples are taken to confirm the high readings. If the high bacteria levels are confirmed, the beach is posted with a sign that informs the public that the beach may not be safe for swimming because of high bacterial counts. A beach is closed at the discretion of the owner.

In 1998, eight beaches were posted and three were temporarily closed; in 1999, nine beaches were posted and four closed. In most cases the closures were for a few days until a re-sample could be analyzed. The exceedances were generally attributed to heavy swim loads or to stormwater runoff. In at least one instance, high counts were not associated with a heavy swim load or a recent storm; the source is unknown. Table III-8-3 lists the waterbodies affected by beach closures or postings during the reporting period.

8.3.6 Waters Affected By Drinking Water Restrictions

Since 1998, one boil order has been issued in the community of Greenville because of bacteria found in the distribution system. It is important to recognize however that the boil order lasted less than a week and was not issued because the surface water supply was polluted. Most, if not all, surface waters contain bacteria in concentrations that exceed the stringent Safe Drinking Water Act (SDWA) standards. Rather, inadequate disinfection of the source water or the distribution system due either to mechanical or operator failure is believed to be the reason why some bacteria was detected and why boil orders had to be issued.

A list of waterbodies used for public water supplies is included in Appendix D (Tables D-1 and D-2). Summaries of drinking water use assessments are shown in Tables III-8-4 and III-8-5. Only waters used for public water supplies were assessed for drinking water uses. As shown all 245 miles of rivers and all 11699 acres of lakes and reservoirs used for public supplies are considered fully supporting of this use based on a review of finished (treated) water quality and restrictions on drinking water supplies.

8.3.7 Waters Affected By Waterborne Diseases

Since 1998, no documented incidents of waterborne diseases have occurred.

Table III-8-3
Waterbodies Affected by Bathing Area Closures or Postings

Waterbody Name	Size Affected	Cause(s) of Concern	Source(s) of Pollutants	Comments	Month/Year of Closure or Posting
Great Pond (Kingston)	.2 acre	Bacteria (E. coli)	Heavy Swim Loads	Occasional	June, 1998 & 1999
Catamount Pond (Allenstown)	.2 acre	Bacteria (E. coli)	Heavy Swim Loads	Occasional	June, 1998 June/July, 1999
Mill Pond (Washington)	.2 acre	Bacteria (E. coli)	stormwater runoff	Occasional	July,1998 & 1999
Bean Brook (Piermont)	.2 acre	Bacteria (E. coli)	stormwater runoff	Occasional	July, 1998
Berry Pond Brook (Pittsfield)	.2 acre	Bacteria (E. coli)	Heavy Swim Loads	Occasional	July, 1998
Waumbek Inn Brook (Jefferson)	.2 acre	Bacteria (E. coli)	stormwater runoff	Occasional	July, 1998
Tannery Pond (Wilmot)	.2 acre	Bacteria (E. coli)	Heavy Swim Loads	Occasional	August, 1998
Beards Brook (Hillsboro)	.2 acre	Bacteria (E. coli)	stormwater runoff	Occasional	July, 1998
Webster Lake (2 beaches) (Franklin)	.2 acre	Bacteria (E. coli)	Heavy Swim Loads	Occasional	June/July, 1999
Sunrise Lake (Middleton)	.2 acre	Bacteria (E. coli)	Heavy Swim Loads	Occasional	July, 1999
Everett Lake (Weare)	.2 acre	Bacteria (E. coli)	Unknown	Occasional	July, 1999
Millen Lake (Washington)	.2 acre	Bacteria (E. coli)	Heavy Swim Loads	Occasional	July, 1999
Carroll Lake (Raymond)	.2 acre	Bacteria (E. coli)	Heavy Swim Loads	Occasional	August, 1999

Table III-8-4
Summary of Drinking Water Use Assessments for Rivers and Streams

Total Miles Designated for Drinking Water Use = 245.0[(1)] Total Miles Assessed for Drinking Water Use = 245.0				
Miles Fully Supporting Drinking Water Use	245.0	% Fully Supporting Drinking Water Use	100.0%	Contaminants
Miles Fully Supporting but Threatened for Drinking Water Use	0.0	% Fully Supporting but Threatened for Drinking Water Use	0.0%	
Miles Partially Supporting Drinking Water Use	0.0	% Partially Supporting Drinking Water Use	0.0%	
Miles Not Supporting Drinking Water Use	0.0	% Not Supporting Drinking Water Use	0.0%	

(1) By State law, all surface waters shall be suitable for drinking after adequate treatment. This implies that surface waters don't have to be potable prior to treatment. Consequently all surface waters most likely fit this definition. For this report, however, only the surface waters currently used as public water supplies were included in the assessment.

Table III-8-5
Summary of Drinking Water Use Assessments for Lakes and Reservoirs

Total Acres Designated for Drinking Water Use = 11699 (1) Total Acres Assessed for Drinking Water Use = 11699				
Acres Fully Supporting Drinking Water Use	11699.0	% Fully Supporting Drinking Water Use	100.0%	Contaminants
Acres Fully Supporting but Threatened for Drinking Water Use	0.0	% Fully Supporting but Threatened for Drinking Water Use	0.0%	
Acres Partially Supporting Drinking Water Use	0.0	% Partially Supporting Drinking Water Use	0.0%	
Acres Not Supporting Drinking Water Use	0.0	% Not Supporting Drinking Water Use	0.0%	

(1) By State law, all surface waters shall be suitable for drinking after adequate treatment. This implies that surface waters don't have to be potable prior to treatment. Consequently all surface waters most likely fit this definition. For this report, however, only the surface waters currently used as public water supplies were included in the assessment.

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PART IV

GROUNDWATER ASSESSMENT

PART IV, CHAPTER I

OVERVIEW OF GROUNDWATER CONTAMINATION SOURCES

1.1 GENERAL SUMMARY OF GROUNDWATER QUALITY

Natural groundwater quality is generally good. The predominant crystalline rock formations produce groundwater of low mineral content, hardness and alkalinity. Although the majority of groundwater can be used as a drinking water source, most groundwater is highly corrosive to water supply distribution systems. Ambient groundwater quality from stratified drift aquifers can be impacted by such aesthetic concerns as iron, manganese, taste and odor. Bedrock well water quality is sometimes impacted by naturally occurring contaminants including fluoride, arsenic, mineral radioactivity and radon gas. Elevated concentrations of radon gas occur frequently in bedrock wells.

In addition to naturally occurring contaminants, there are many areas of localized contamination due primarily to releases of petroleum and volatile organic compounds from petroleum facilities, commercial and industrial operations and landfills. Due to widespread winter application of road salt, sodium is also a contaminant of concern in New Hampshire groundwater.

Table IV-1-1 summarizes available aquifer monitoring data for New Hampshire. Because of changes to New Hampshire's Public Water Supply Database, it is not possible to provide much of the information identified in the chart. Work to rectify our reporting ability is underway. A copy of the Ambient Groundwater Quality Standards for New Hampshire is provided in Appendix H.

Table IV-1-1 Aquifer Monitoring Data

Aquifer Description (1) State of New Hampshire County(ies) (optional) (2) _____
Aquifer Setting (1) Fractured Bedrock, Stratified Drift and Glacial Till Longitude/Latitude (optional) (3) _____
Data Reporting Period (4) 1998 - 2000

Monitoring Data Type	Total No. of Wells Used in the Assessment (5)	Parameter Groups Number	Number of Wells								
			No detections of parameters above MDLs or background levels		No detections of parameters above MDLs or background levels and nitrate concentrations range from background levels to less than or equal to 5 mg/l. *(INA)*		Parameters are detected at concentrations exceeding the MDL but are less than or equal to the MCLs (10) *(INA)*	Parameters are detected at concentrations exceeding the MCLs (11)	Removed from service (12)	Special Treatment (13)	Background parameters exceed MCLs (14) *(INA)*
			ND (6)	Number of wells in sensitive or vulnerable areas (Optional) (7)	ND/ Nitrate# 5 mg/l (8)	Number of wells in sensitive or vulnerable areas (optional) (9)					
Ambient Monitoring Network (Optional) *(INA)*		VOC									
		SOC									
		NO3									
		Other (15)									
Raw Water Quality Data from Public Water Supply Wells		VOC									
		SOC									
		NO3									
		Other(15)									
Finished Water Quality Data from Public Water Supply Wells *(INA)*	Can only report on the number of samples from PWS systems, not by wells.	VOC	740	All			807 Detects	Can't report	Can't report	Can't report	
		SOC	487	All			78 Detects	Can't report	Can't report	0	
		NO3	3234	All			38 > 5	7 > 10	4	1	
		Other (15)									

Table IV-1-1. (continued)

Monitoring Data Type	Total No. of Wells Used in the Assessment (5)	Parameter Groups	Number of Wells								
			No detections of parameters above MDLs or background levels		No detections of any parameters above MDLs or background levels and nitrate concentrations range from background levels to less than or equal to 5 mg/l. *(INA)*		Parameters are detected at concentrations exceeding the MDL but are less than or equal to the MCLs and/or nitrate ranges from greater than 5 to less than or equal to 10 mg/L (10) *(INA)*	Parameters are detected at concentrations exceeding the MCLs (11)	Removed from service (12)	Special Treatment (13)	Background parameters exceed MCLs (14) *(INA)*
			ND (6)	Number of wells in sensitive or vulnerable areas (optional) (7)	ND/ Nitrate# 5 mg/l (8)	Number of wells in sensitive or vulnerable areas (optional) (9)					
Raw Water Quality Data from Private or Unregulated Wells (optional) *INA except NO3*	3165	VOC									
		SOC									
		NO3						48	0	0	0
		Other (15)									
Other Sources (optional)		VOC									
		SOC									
		NO3									
		Other (15)									

Major uses of the aquifer or hydrologic unit (optional) (16)	_/_ Public water supply ____ Irrigation _/__ Commercial ____ Mining ____ Baseflow _/_ Private water supply ____ Thermoelectric ____ Livestock _/__ Industrial ____ Maintenance
Uses affected by water quality problems (optional) (16)	__/ Public water supply ____ Irrigation ____ Commercial ____ Mining ____ Baseflow __/ Private water supply ____ Thermoelectric ____ Livestock ____ Industrial ____ Maintenance

INA = Information not available.

PART IV, CHAPTER 2

OVERVIEW OF STATE GROUNDWATER PROTECTION PROGRAMS

Table IV-2-1 provides a summary of the myriad of State and Federal groundwater protection programs that are currently in place in New Hampshire. New Hampshire was one of the first four States in the Nation to receive EPA's endorsement of its comprehensive approach to groundwater protection. This endorsement is an acknowledgment that the State has an array of local, state and federal groundwater protection programs in place which are sufficiently coordinated to effectively protect groundwater. The state routinely engages all stakeholders in a process to identify and jointly address groundwater issues of concern. The State is currently developing the second, five-year Groundwater and Drinking Water Strategy work plan with stakeholders, having successfully completed a number of important initiatives under the first work plan.

Wellhead protection continues to be a major focus of groundwater protection efforts, with more than 80% of the Public Water Systems in New Hampshire having implemented wellhead protection measures to ensure high quality drinking water. Groundwater availability issues are of increasing concern. This concern has led to the passage of statutes that require any adverse impact to surrounding water resources from a large groundwater withdrawal be assessed and mitigated.

Table IV-2-1
Summary of State Groundwater Protection Programs

Programs or Activities	Check (T) (1)	Implementation Status (2)	Responsible State Agency (3)
Active SARA Title III Program	/	Fully Established	OEM
Ambient groundwater monitoring system	/	Under Development	NHDES
Aquifer vulnerability assessment	Not Applicable	Not Applicable	Not Applicable
Aquifer mapping	/	Fully Established	USGS, NHDES
Aquifer characterization	/	Fully Established	USGS, NHDES
Comprehensive data management system	/	Continuing Efforts	NHDES, GRANIT
EPA-endorsed Core Comprehensive State Groundwater Protection Program (CSGWPP)	/	Fully Established	NHDES*
Groundwater discharge permits	/	Fully Established	NHDES
Groundwater Best Management Practices	/	Fully Established	NHDES
Groundwater legislation	/	Fully Established	NHDES
Groundwater classification	/	Fully Established	NHDES
Groundwater quality standards	/	Fully Established	NHDES
Interagency coordination for groundwater protection initiatives	/	Fully Established	NHDES
Nonpoint source controls	/	Fully Established	NHDES
Pesticide State Management Plan	/	Fully Established	NHDES
Pollution Prevention Program	/	Continuing Efforts	NHDES
Resource Conservation and Recovery Act (RCRA) Primacy	/	Fully Established	NHDES
State Superfund	/	Fully Established	NHDES
State RCRA Program incorporating more stringent requirements than RCRA Primacy	/	Fully Established	NHDES
State septic system regulations	/	Fully Established	NHDES
Underground storage tank installation requirements	/	Fully Established	NHDES
Underground Storage Tank Remediation Fund	/	Fully Established	NHDES
Underground Storage Tank Permit Program	/	Fully Established	NHDES
Underground Injection Control Program	/	Fully Established	NHDES
Vulnerability assessment for drinking water/wellhead protection	/	Fully Established	NHDES
Well abandonment regulations	/	Fully Established	NHDES
Wellhead Protection Program (EPA-approved)	/	Fully Established	NHDES
Well installation regulations	/	Fully Established	NHDES

PART IV, CHAPTER 3

SUMMARY OF GROUNDWATER QUALITY

Table IV-3-1 identifies the ten highest priority sources of groundwater contamination. Underground storage tanks and industrial/commercial facilities top this list and are by far the leading causes of localized groundwater degradation in New Hampshire. Table IV-3-2 provides information on the type of contamination sites and their relative numbers.

Table IV-3-1
Major Sources of Groundwater Contamination

Contaminant Source	Ten Highest Priority Sources (T)	Factors Considered in Selecting a Contaminant Source (1)	Contaminants (2)
Agricultural Activities			
Agricultural chemical facilities			
Animal feedlots			
Drainage wells			
Fertilizer applications			
Irrigation practices			
Pesticide applications			
Storage and Treatment Activities			
Land application			
Material stockpiles			
Storage tanks (above ground)	T	A-E	D
Storage tanks (underground)	T	A-E	D
Surface impoundments			
Waste piles			
Waste tailings			
Disposal Activities			
Deep injection wells			
Landfills	T	A-E	C,D,H
Septic systems	T	A-E	C,L,E
Shallow injection wells	T	A-E	C,D
Other			
Hazardous waste generators	T	A-E	C,D,H
Hazardous waste sites	T	A-E	C,L,E
Industrial facilities	T	A-E	C,D
Material transfer operations			
Mining and mine drainage			
Pipelines and sewer lines			
Salt storage and road salting	T	A-E	G
Salt water intrusion			
Spills	T	A-E	C,D
Transportation of materials			
Urban runoff			
Other sources (please specify)			
Other sources (please specify)			

See Notes on the next page.

Notes for Table IV-3-1:

(1) Factors used to select each of the contaminant sources:

A. Human health and/or environmental risk (toxicity)
B. Size of population at risk
C. Location of sources relative to drinking water sources
D. Number and /or size of contaminated sources
E. Hydrogeologic sensitivity
F. State findings, other findings
G. Documented from mandatory reporting
H. Geographic distribution/occurrence
I. Other criteria

(2) List of contaminants/classes of contaminants considered to be associated with each of the sources checked.

A. Inorganic Pesticides
B. Organic Pesticides
C. Halogenated solvents
D. Petroleum compounds
E. Nitrate
F. Fluoride
G. Salinity/Brine
H. Metals
I. Radionuclides
J. Bacteria
K. Protozoa
L. Viruses
M. Other

Table IV-3-2
Groundwater Contamination Summary

Aquifer Description (1) State of NH
Aquifer Setting (1) Fractured Bedrock, Stratified Drift and Glacial Till
County(ies) (optional) (2) _____
Longitude/Latitude (optional) (3) _____
Data Reporting Period (4) Through December 1999

Source Type	Present in reporting area (circle) (5)	Number of sites in area	Number of sites that are listed and/or have confirmed releases	Number of confirmed groundwater contamination	Contaminants (6)	Number of site investigations (optional)	Number of sites that have been stabilized or have had the source removed (optional)	Number of sites with corrective action plans (optional)	Number of sites with active remediation (optional)	Number of sites with cleanup completed (optional)
NPL	Yes	18	18	18	VOCs, Metals	18			15	0
CERCLIS (non-NPL)	Reported under State Sites									
DOD/DOE	Yes	2	2	2	VOCs	2		2		
LUST	Yes	1933	1933	1933	VOCs	1933				939
RCRA Corrective Action	Yes	2	2	2	VOCs	2				
Underground Injection	Yes	1174			VOCs, Metals					803
State Sites	Yes	598	598	598	VOCs, Metals	598				233
Nonpoint Sources (7)	Yes									
Other (specify)	No									
Totals (8)		**3727**	**2553**	**2553**	VOCs, Metals	**2553**	**N/A**	**N/A**	**N/A**	**1975**

No information available for blocks left blank.

NPL - National Priority List
DOD - Department of Defense
RCRA - Resource Conservation and Recovery Act
DOE - Department of Energy
LUST - Leaking Underground Storage Tanks
CERCLIS (non-NPL) - Comprehensive Environmental Response, Compensation, and Liability Information System